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Physics Abstracts

Volume 64 AUGUST 1961 Number 764

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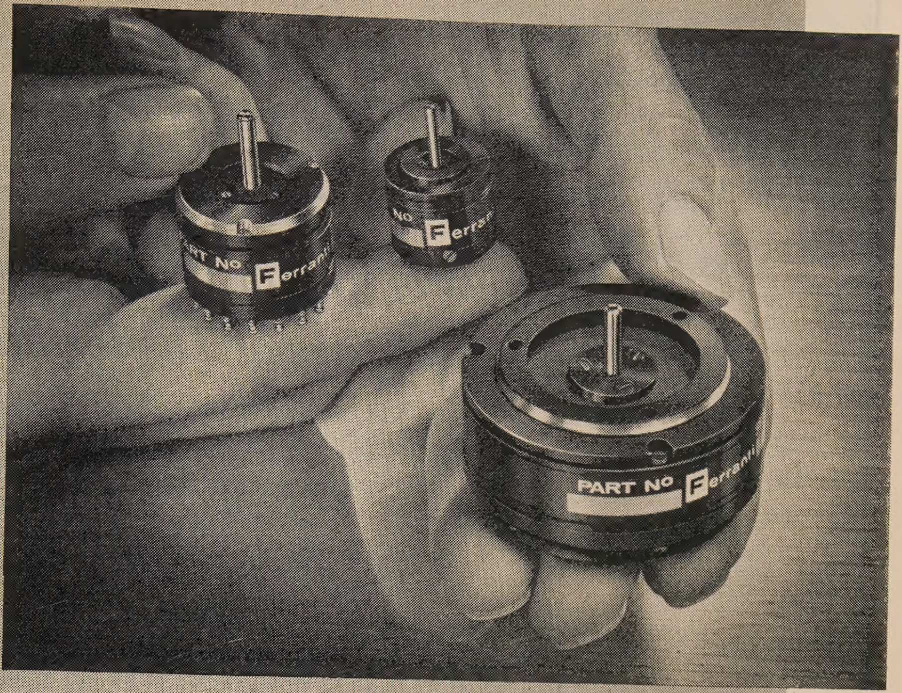

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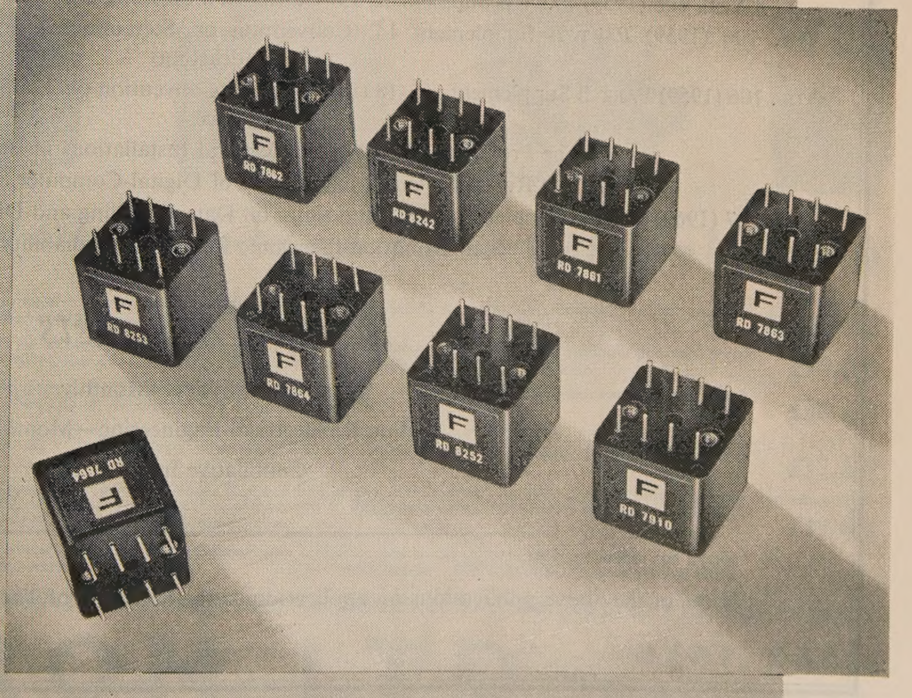

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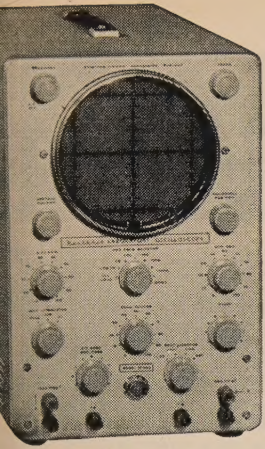

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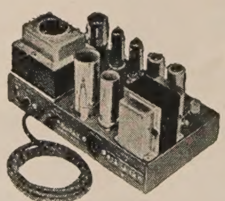

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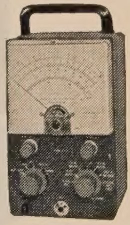

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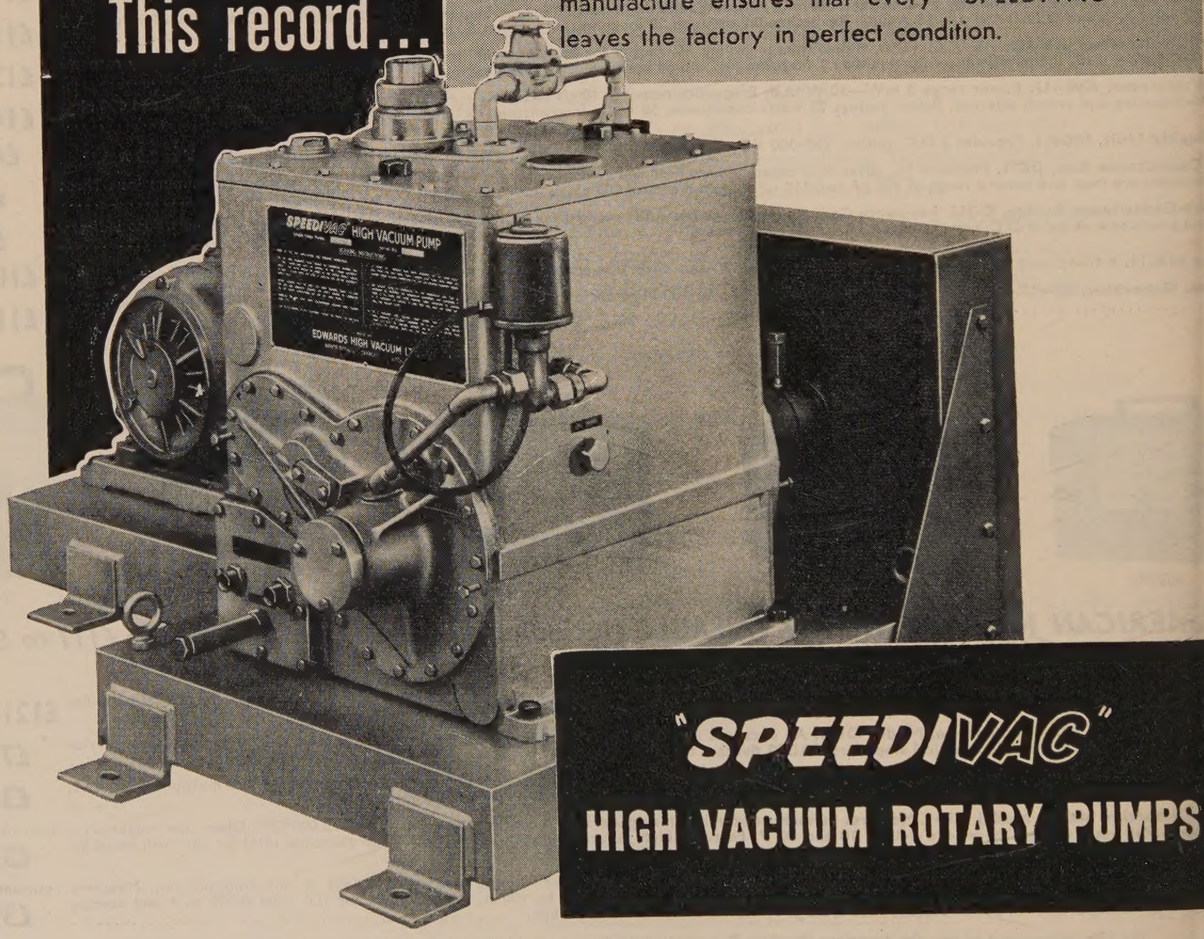

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MATHEMATICS

243 SYMMETRIC AND ANTISYMMETRIC TENSORS OF THE SECOND ORDER AND THEIR FUNCTIONS.
roy.
Acad. Roy. Belgique Cl. Sci., Vol. 47, No. 1, 25-41 (1961).
ench.
The maximum number of distinct symmetric quadratic tensors
iven, in the same way as the maximum number of distinct
-symmetric quadratic tensors can be built up with the aid
e components of a real asymmetric quadratic tensor only.
e numbers are effectively shown to be attained in the case
e four-dimensional spaces of the unified field theory of
itation and electromagnetism.

9244 DETERMINATION OF SOLID ANGLES. V.I.Lozgachev.
tekh. Fiz. (USSR), Vol. 30, No. 9, 1109-14 (Sept., 1960).
ussian.
Shows how to calculate a solid angle subtended by a circular or
r plane target at a point source. The treatment is extended to
l angles in the case of a target and a source in the form of
ial disks; the results are tabulated. [English translation in:
et Physics - Technical Physics (USA), Vol. 5, No. 9, 1939-44
ch, 1961)]. A.Tybulewicz

9245 FIELD COMPUTATIONS IN ENGINEERING AND PHYSICS. A.Thom and C.J.Apelt.
London, Toronto, New York, Princeton, N.J.: D.Van Nostrand (1961) vii + 165 pp.

The book describes the method of squares for the numerical solution of elliptic partial differential equations. The method was first developed by Professor Thom in the 1920's for the solution of non-linear hydrodynamic equations, and is basically a systematic method of iteration to solve the difference equations approximating to the differential equations at each lattice point, with special techniques to accelerate convergence. Although developed initially for desk computation, most of the techniques are equally applicable for electronic digital computers, and are more easily programmed than relaxation methods. The authors are confident that it is the simplest, fastest and most efficient technique of obtaining numerical solutions to all types of field problems. The solution of the equations of Laplace and Poisson are covered in some detail, including a consideration of the rate of convergence and accuracy of the method. In addition it is shown how the method can be applied to the non-linear equations governing the flow of a compressible fluid and the flow of a viscous fluid, both in two dimensions and in three dimensions with axial symmetry. The methods of solution are illustrated by worked examples for several typical cases. An adequate bibliography is provided. H.Morrison

AN ANALOGUE METHOD FOR DEALING WITH MAGNETIC FIELDS IN NONLINEAR ANISOTROPIC MEDIA.
See Abstr. 9021

ASTROPHYSICS

246 ON THE CORRECTION OF DISPERSION FOR OBSERVATIONAL ERROR. A.J.Wesselink.
rvatory (GB), Vol. 81, 17-18 (Feb., 1961).
Discusses the statistical problem of correcting the dispersion
frequency distribution for observational error when the obser-
ns differ in accuracy. It is shown that Trumpler and Weaver's
ula (1953) for the true dispersion, when the individual obser-
ns have unequal weights, is liable in certain circumstances to
eciable inaccuracy by giving too much weight to the poorer
rvations. A method of overcoming this defect is developed; and
teps involved in the actual calculation of the true dispersion are
erated. D.R.Barber

247 SCHWARZSCHILD'S CRITERION. P.Souffrin.
Acad. Sci. (France), Vol. 252, No. 14, 2073-4 (April 5, 1961).
ench.
This, and another condition for instability, are obtained from
quations of hydrodynamics and a simplified energy equation.
G.A.Chisnall

248 COSMOLOGICAL SIGNIFICANCE OF ANGULAR MEASUREMENTS OF DISTANT RADIO SOURCES.
vidson.
e (GB), Vol. 189, 991 (March 25, 1961).
n steady-state cosmology the angular diameters tend to
ero limits at the observational horizon. Predictions concerning
ar diameters can also be made in special cases for evolutionary
relativistic model universes, and angular measurements would provide an observational test. In the application of such a test, however, it is to be noted that the infrared surface brightness of a source would depend upon the red shift. A formula derived for the surface brightness function for a source at distance δ is $B(\nu, t) = (1 + \delta)^3 \Delta I(\nu_0)$ per unit solid angle, where $\Delta I(\nu_0)$ is the observed energy flux from unit area at frequency ν_0 at the observer. R.A.Newing

9249 THE INTERPRETATION OF COSMOLOGY. B.Balázs and G.Paál.
Nature(GB), Vol. 189, 992-3 (March 25, 1961).

A critical discussion of McCrea's suggestion of an inherent uncertainty in the predictions of cosmological theories. R.A.Newing

9250 GALACTIC MOTIONS IN A LARGE-SCALE MAGNETIC FIELD. D.G.Wentzel.
Nature (GB), Vol. 189, 907-8 (March 18, 1961).

In a review of present theoretical and observational evidence for a macro-circulation of interstellar gas between the galactic plane and halo, it is pointed out that the halo should be considered as source of both gas, and angular momentum. To sustain such large-scale circulation, interstellar magnetic fields of $\sim 2.10^{-5}$ g in the galactic plane, and $\sim 6.10^{-6}$ g in the halo are invoked for a model with a (halo) gas density of 10^{-2} H atom/cc. Scales of both magnetic, and velocity fields are of the order of several kiloparsecs. Estimates are given of the forces acting on the gas at the centre of a 3 kpsc arm that lead to radially-outward velocities of ~50 km/sec, in agreement with recent observations.

D.R.Barber

9251 SPALLATION OF INTERSTELLAR MATTER: COSMIC-RAY INTENSITY IN THE PAST.

S.N.Milford and S.P.Shen.

Phys. Rev. (USA), Vol. 122, No. 6, 1921-2 (June 15, 1961).

It is pointed out that spallation of interstellar matter by cosmic rays occurs, and that the lithium, beryllium, and boron thus produced can be used as rough indexes of the average interstellar cosmic-ray intensity. Using available data, this method gives an upper limit of the order of 10 cm^{-2} sec^{-1} for the intensity of interstellar cosmic rays of kinetic energy $>\sim 50$ MeV, averaged temporally over the past few billion years and spatially over several cubic kiloparsecs in the solar neighbourhood.

9252 STEADY COMPONENT OF THE INTERPLANETARY MAGNETIC FIELD: PIONEER V.

P.J.Coleman, Jr, L.Davis and C.P.Sonett.

Phys. Rev. Letters, Vol. 5, No. 2, 43-6 (July 15, 1960).

Observations made with the magnetometer carried aboard Pioneer V are examined for the first 50 days of operation. These observations suggest that, at this stage of the solar cycle, the interplanetary magnetic field, when undisturbed, is nearly constant in magnitude and nearly uniform in direction over the region explored so far. This is inconsistent with many models of the interplanetary field and it is suggested that the field might originate in a ring current in the equatorial plane of the sun, similar to the model proposed by Elliot [Nature (GB), Vol. 186, 299 (1960)].

A.Boksenberg

9253 STRESS HISTORY OF THE MOON.

G.J.F. MacDonald.

Planet. Space Sci. (GB), Vol. 2, No. 4, 249-55 (Aug., 1960).

The character of the lunar surface indicates that surface faulting has not been an important mechanism for the build-up of the lunar surface. If the radioactive content of the Moon is of the same order as that of chondritic meteorites, then the absence of major surface faults can be explained in a number of ways. A near-surface concentration of radioactivity will provide an equality of heat production and surface heat flow necessary for the maintenance of a constant lunar radius. Alternatively, the radioactivity could be deeply buried, with the radius still remaining constant over the past 2 000 million years. Heat transported by mechanisms other than radiation and thermal conduction will also tend to keep the radius of the Moon at a constant value. Even though the radius of the Moon remains constant, there is a major build-up of strain energy throughout the Moon. The rate is such that, on the average, something of the order of 10^{24}-10^{25} ergs of distortional energy should be released per year throughout the Moon, provided the radioactivity is uniformly distributed. A near-surface concentration of the radioactivity might decrease this rate of energy release but certainly by no more than an order of magnitude. Under all circumstances it would appear that a Moon of chondritic composition would have strong seismic activity.

9254 A GEOLOGICAL INTERPRETATION OF THE LUNAR SURFACE. S.Miyamoto.

Planet. Space Sci. (GB), Vol. 2, No. 4, 256-60 (Aug., 1960).

The interpretation of lunar surface features is based on the differentiation of siliceous and basaltic substances similar to those of the earth. It is hypothesized that lunar maria are composed of basaltic matter similar to that of terrestrial ocean basins, and that the lunar continents (bright regions) are composed of siliceous blocks.

9255 THE CONSTITUTIONS OF URANUS AND NEPTUNE.

W.S.Porter.

Astron. J. (USA), Vol. 66, No. 5, 243-5 (June, 1961).

The internal constitutions have been investigated on the basis of the assumption that solid ammonium is a major constituent of these planets. An equation of state found by Bernal and Massey for this substance has been employed together with the equation of hydrostatic equilibrium to find the internal density and mass distributions. The presence of undetermined, more dense materials has been allowed for in a phenomenological manner and it has been found that the ammonium contents are 84 and 74% for Uranus and Neptune, respectively. Both planets appear to have dense cores of heavy material of approximately twice the mass of the earth.

9256 ON THE DETERMINATION OF ORBITS OF COMET AND ASTEROIDS. P.Kustaanheimo.

Comment. phys.-math. (Finland), Vol. 25, No. 2, 47 pp. (1960).

A method of preliminary orbit determination from three or observations is presented in detail. The method is especially suited for high-speed digital computers, because the equation of Lagrange–Gauss is not used. The orbit is computed by direct iteration, beginning with the same initial values in all cases. T method is illustrated with six complete numerical examples. T elements of the osculating orbit of an artificial earth satellite c be determined by this same method, when the numerical consta are adapted to the units used in satellite work.

9257 REDUCTION OF METEOR VELOCITIES FROM CONTINUOUS-WAVE RADIO RECORDS.

D.W.R.McKinley and E.L.R.Webb.

Monthly Not. Roy. Astron. Soc. (GB), Vol. 122, No. 3, 255-62 (1

Mainstone (Abstr. 14403 of 1960) has suggested that there be a large negative bias, averaging −5% or more, in meteor velocities which are reduced from continuous-wave records of meteor diffraction echoes by means of the Ottawa velocity form An analysis of the particular reduction technique employed to reduce the Ottawa records shows that the statistical bias, if any was positive, and was probably less than 1%.

9258 ORIGIN OF STONE AND IRON METEORITES.

D.E.Fisher.

Nature (GB), Vol. 190, 244-5 (April 15, 1961).

There is a discrepancy between the cosmic-ray exposure a for stone and iron meteorites as determined by helium-3 meas ments, which has led Urey (Abstr. 10498 of 1960) to suggest dif ent origins and histories for the two types of meteorite. Howev when corrections are made to the age estimates to allow for the difference of cross-section for helium-3 production, for the de effect and for space erosion, it seems probable that the age dis ancy will disappear.

D.M.

9259 MICROMETEORITE IMPACTS TO AN ALTITUDE 135 km. J.F.Lovering.

Planet. Space Sci. (GB). Vol. 2, No. 1, 75-7 (Oct., 1959).

Artificial earth satellite measurements of micrometeorit influx rates revealed short term bursts of the order of 10 m^{-2} superimposed on a background rate several orders of magnitu smaller. Berg and Meredith [J. geophys. Res. (USA), Vol. 6, 751 (Dec., 1956)] reported about 160 $m^{-2}sec^{-1}$ above 85 km on Aerobee fired to 103 km during a Leonid shower. A detector similar to that of Berg and Meredith was fired to 135 km on a Tom and no impacts were recorded on 82 cm^2 during 210 secs above 85 km. The measurement coincided with no known mete shower.

D.M.

9260 SODIUM 22 IN THE METEORITE BREITSCHEID.

E.Vilcsek and H.Wänke.

Z. Naturforsch. (Germany), Vol. 15a, No. 11, 1004-7 (Nov., 19

In German.

The first successful estimation of the Na^{22} content was ca out on the meteorite Breitscheid, which fell on the 11th August The experimentally determined counting rate of 0.21 ± 0.03 p minute extrapolated to the time of the fall, gave 0.089 ± 0.015 decays/minute/gram. Using the relatively short halflife of Na 2.6 years the mean cosmic ray intensity for the years 1954-1 was found to be 0.68 particles/cm^2 sec sterad. This value inc particles with energies down to about 100 MeV. The daughter content together with the Na^{22} decay rate gave a radiation age about 3 × 10^7 years for this meteorite.

S.J.St-

9261 SCANDIUM 45 AS REACTION PRODUCT OF HIGH ENERGY PARTICLES IN IRON METEORITES. II

H.Wänke.

Z. Naturforsch. (Germany), Vol. 15a, No. 11, 953-64 (Nov., 1

In German.

For Pt I, see A bstr. 4213 of 1959. It is suggested that t scandium content of a meteorite gives a clear indication of th energy particles met by the meteorite. (Energy range 200-1 It is estimated that there are 2.1 times as many particles wi energy under 1 GeV as above it. The total intensity is estim 0.65 particles cm^{-2} sec^{-1} $sterad^{-1}$.

J.M

9262

Xe^{129} IN THE METEORITE ABEE.

J. Zähringer and W. Gentner.
Iaturforsch.(Germany), Vol. 16a, No. 3, 239-42 (March, 1961).
erman.

A degassing experiment (in steps at different temperatures) vs that radiogenic A^{40} and primordial A^{36} are trapped differently ie Abee enstatite chondrite. A^{40} diffuses out easily at low peratures, while A^{36} is released essentially at temperatures er than 1000°C. Xe^{129} follows the amount of primordial A^{36} the Xe^{129}/Xe^{132} ratio is 5.5 at all temperatures This may indi- that all xenon isotopes have been included as primordial gas care should be taken to relate it to the iodine content of the sent meteorite sample or to add the I—Xe age to the K—A age ie meteorite.

263

EXPOSURE AGES FOR IRON METEORITES.

O.A.Schaeffer and D.E.Fisher.
re (GB), Vol. 186, 1040-1 (June 25, 1960).

9264

EXPOSURE AGES FOR IRON METEORITES.

H.Wänke.
ire (GB), Vol. 188, 1101 (Dec. 24, 1960).

9265

COSMIC RAY AGES OF THE TREYSA AND SIKHOTE–ALIN METEORITES.

D.E.Fisher.
ire (GB), Vol. 190, 225-7 (April 15, 1961).

An error in a previous calculation of He^3 production rate in Treysa meteorite (preceding abstracts) is corrected, and He^3 production rate versus He^3/A^{38} ratio diagram is corrected discussed. The ages proposed as "best" are 0.16×10^9yr for ote–Alin and, for Treysa, 1.3×10^9yr if the diagram is used to mate the nuclide production rate, or 0.35×10^9yr if the A^{38} data accepted as indicating the primary flux. D.M.Gilbey

9266

THE EXPOSURE AGE OF IRON METEORITES FROM Cl^{36} MEASUREMENTS.

E.Vilcsek and H.Wänke.
Iaturforsch. (Germany), Vol. 16a, No. 4, 379-84 (April, 1961).
erman.

Cl^{36}, which is produced by the interaction of cosmic-ray particles nuclei in meteorites, was measured in seven iron meteorites in one stone meteorite. The decay rates for Cl^{36} in iron meteo- s varied between 6.5 and 20.2 d.p.m./kg. From these and from concentration of stable spallation products, the exposure ages of e meteorites were calculated. In this way exposure ages close 00 million years were found for six of the meteorites examined. for the Sikhote Alin meteorite was the quite different exposure of 60 million years measured. As this value is also definitely r than that found by other authors for this meteorite, it is gested that the Sikhote Alin had been part of a bigger meteorite h was broken into pieces about 60 million years ago by a col- n with another meteorite.

9267

ON STRUCTURE OF MAGNETIC FIELD OF THE SUN.

I.K.Csada.
phys. chem. Szeged. (Hungary), Vol. 4, No. 3-4, 77-85 (1958).

Making the tacit assumptions that the sun's general magnetic is clearly delineated only in the polar regions, and that the r coronal streamers follow the lines of force of this field, the poral fluctuations of the streamer pattern are analysed mathe- ically by making use of Legendre functions to represent the or field potential. The results imply that the streamer pattern — hence the general field distribution — changes in step with the ear solar magnetic cycle. D.R.Barber

9268

SOME SOLAR LINES IN THE INFRA-RED SPECTRUM OBSERVED FROM A HIGH-FLYING AIRCRAFT.

P.Hughes and T.S.Moss.
ire (GB), Vol. 189, 908-9 (March 18, 1961).

Two electronic transitions of solar H, (3-4) and (4-8), that lie ie great H_2O absorption band at 1.9 μ, and are quite invisible ground-level up to the highest mountain sites available for trographic observations, are clearly shown in spectrograms ntly obtained from an aircraft flying at 40 000 ft. The lines re- at about the same intensity at greater heights, thus confirming solar origin. A new solar line in the 2.6 μ H_2O band, and due e (4-6) H transition, has been detected on the same spectro- as. D.R.Barber

9269

A DETERMINATION IN ADVANCE OF THE POSITION OF THE NEXT SUNSPOT MINIMUM.

F.Baur.
Z. Astrophys. (Germany), Vol. 52, No. 1, 37-41 (1961).
In German.

Calculations based on the relationship between the asymmetric intervals of the ranges, $\frac{1}{2}R_M \rightarrow R_M$, $R_M \rightarrow \frac{1}{2}R_M$, and the absolute value of the sunspot maximum, R_M, in 18 eleven-year cycles between 1755 and 1954, yield a prediction that the next minimum, R_m, will fall between June 1964 and December 1965, probably in February 1965. D.R.Barber

9270

HIGH-ENERGY X-RAYS DURING SOLAR FLARES.

J.I.Vette and F.G.Casal.
Phys. Rev. Letters (USA), Vol. 6, No. 7, 334-6 (April 1, 1961).

The detector was a balloon-borne NaI scintillation counter, flown to 120 000 ft, and pointed at the sun. Two solar flares, one class 2 and the other class 1, as well as radio disturbances, occurred during a flight on Oct. 12, 1960. X-rays were detected in three energy classes, >20 keV, >80 keV, and >150 keV. For the class 1 flare, a differential X-ray energy spectrum is calculated as a power law with exponent −1.6. Assuming production to be caused by electron bremsstrahlung in the solar chromosphere, and using the decay time for the X-ray burst of about 100 sec, the depth of production in the chromosphere is estimated. The peak intensity of the class 1 flare event at the top of the atmosphere is estimated at 1.2×10^{-6} erg cm^{-2} sec^{-1}, and that for the class 2 event about twice as much. N.A.Porter

9271

A PROCEDURE FOR PHOTOGRAPHING THE SOLAR CORONA DURING TOTAL ECLIPSES.

M.Laffineur, M.Bloch and M.Bretz.
C.R. Acad. Sci. (France), Vol. 252, No. 15, 2180-1 (April 10, 1961).
In French.

Two methods of overcoming the restrictions imposed on coronal photography because of the steep radial brightness-gradient in the photographic image are outlined. The first requires a constant exposure time over the entire field, and employs a radially-distributed neutral absorbing wedge centred on the coronal image. The second involves compensated exposure through a rapidly-rotating diaphragm shutter whose aperture is cut to follow a polar curve computed empirically from known data for the brightness-field surrounding the image of the solar disk. D.R.Barber

9272

INTERFEROMETRIC INVESTIGATION OF EMISSION LINES OF THE SOLAR CORONA DURING THE TOTAL SOLAR ECLIPSE OF 1958 OCTOBER 12.

A.H.Jarrett and H.von Klüber.
Monthly Not. Roy. Astron. Soc. (GB), Vol. 122, No. 3, 223-38 (1961).

The eclipse was observed in the South Pacific. The solar corona was photographed through a Fabry—Perot interferometer, with a 0.35 mm spacer, using narrow-band interference filters for the green (λ 5303 A) and red (λ 6374 A) corona lines respectively. Several good photographs were obtained, standardized photometrically and showing very good interference fringes over the whole corona, in some position angles to more than 1.8 solar radii from the Sun's centre. Immediately before and after the eclipse, interference fringes were photographed in the light of the 5461 A line from a water-cooled mercury 198 isotope lamp, to check the instrumental adjustment and to provide an instrumental fringe profile. Many line profiles and half-widths, corrected for instrumental broadening, were determined for both the corona lines and temperatures derived from them. The mean temperature from the green line was about 3.2×10^6 °K and from the red line 3.5×10^6 °K, with an error of about 10% in each case.

MEAN FREE PATH IN PLASMA: APPLICATION TO THE SOLAR CORONA. See Abstr. 9539

9273

MOTIONS IN SOLAR PROMINENCES.

II. DESCRIPTION OF THE ERUPTING PROMINENCE OF 18 JULY 1956.

I.Izsák.
Z. Astrophys. (Germany), Vol. 45, No. 2, 91-7 (1958). In German.

For Pt I, see Abstr. 6463 of 1959. The motions of 23 knots in this prominence were studied with the aid of 40 photographs taken in Arosa. The velocities and accelerations along the trajectories were deduced. The radial velocities in the prominence were measured with the Zurich spectrohelioscope.

9274 MOTIONS IN SOLAR PROMINENCES.
III. CURRENTS IN THE ERUPTING PROMINENCE OF 13 JULY 1950. I.Izsák.

Z. Astrophys. (Germany), Vol. 46, No. 3, 203-16 (1958). In German.

Based on a series of photographs taken in Arosa, a detailed examination is made of the motions of this prominence. According to their behaviour, the 77 knots measured can be divided into 8 classes (A to J), so that within a single class the motions display common features. The mean velocities and accelerations measured along the trajectories are tabulated.

9275 MOTIONS IN SOLAR PROMINENCES.
IV. THE ERUPTING PROMINENCE OF 11 APRIL 1959.

M.Waldmeier.

Z. Astrophys. (Germany), Vol. 49, No. 3, 153-60 (1960). In German.

The trajectories, velocities and accelerations of a large ascending filament were measured. The filament ascended at the heliographic latitude of -38°, out of a region where neither spots nor faculae were observed. The velocities of the nearly radial motion were up to 477 km/s, the accelerations up to more than twice the gravitational acceleration. The dependence of the acceleration due to the "prominence-force" on the height is similar for the three knots investigated; even more similar are the variations of the three accelerations with the time. The filament is considered as a magnetic bar and its ascent as a breaking, which occurs when the magnetic pressure exceeds a critical value.

9276 ASCENDING PROMINENCE OF 11 APRIL 1959.
I. DESCRIPTION OF THE ERUPTION.

H.Haupt and W.Ellerböck.

Z. Astrophys. (Germany), Vol. 49, No. 3, 192-7 (1960). In German.

The prominence was followed with a Lyot filter of 0.75 A bandwidth and with another birefringent filter of 20 A bandwidth attached to the Kanzelhöhe coronagraph. The development of the prominence and its motions were studied and a time—height diagram was derived.

9277 CONNECTION OF A LOOP PROMINENCE WITH A SUNSPOT.

H.Ramseyer, J.W.Warwick and H.Zirin.

Publ. Astron. Soc. Pacific (USA), Vol. 72, 509-10 (Dec., 1960).

To study the relationship between solar prominence, and disk features, a novel design of chromospheric telescope was built at the High Altitude Observatory, Colorado. A composite photogram of the solar disk is obtained, consisting in a record of the chromosphere and prominences in H_{α} light through a 3 A band-pass filter on which is superposed a picture of the disk at the same wavelength exposed through a 0.75 A band-pass filter. A typical record, secured on 30 April, 1960, is reproduced. D.R.Barber

9278 THE MASS-ACCUMULATING STELLAR MODELS FOR APPLICATION TO THE SECONDARY COMPONENTS OF SOME CLOSE BINARY SYSTEMS. M.Kitamura.

Publ. Astron. Soc. Japan, Vol. 2, No. 1, 1-20 (1960).

The secondary component of a binary system is assumed to accumulate mass ejected from the primary and to generate energy by gravitational contraction. It is found possible to construct a model population I star with a radiative core and convective envelope that provides an adequate representation of secondaries of W Ursae Majoris type binaries. It is estimated that such binaries can spend about 10^{7} years in the contracting stage. R.A.Newing

9279 ON THE EVOLUTION OF MASSIVE STARS.

J.Uchida.

Publ. Astron. Soc. Japan, Vol. 12, No. 1, 128 (1960).

Starting with a model star of mass 10 × M., with an homogeneous chemical composition of 82.9% H, 16.6% He, and 0.5% heavy elements, a sequence of models was constructed on the basis of energy generation by thermonuclear reactions within the convective core. The results suggest that, as this type of star evolves, its position on the H-R diagram first moves upward to the right and then back again to the left of the diagram. It is suggested that the reversal of movement is caused by a depletion of H in the stellar core. D.R.Barber

EMISSION OF PHOTONEUTRINOS AND PAIR ANNIHILATION NEUTRINOS FROM STARS. See Abstr. 8445

9280 PHOTOGRAPHIC PHOTOMETRY WITH THE CAMBRIDGE SCHMIDT TELESCOPE. I. THREE-COLOUR SURVEY OF THE PRAESEPE REGION. A.N.Argue.

Monthly Not. Roy. Astron. Soc. (GB), Vol. 122, No. 3, 197-222 (1961).

An experimental photometric survey of the Praesepe regio
was made, using Becker's R.G.U. system. The instruments we
the Cambridge 17 in. Schmidt telescope, Sartorius and Becker
photometers, and the E.D.S.A.C. I and II computers. A theoret
assessment of the performance of the telescope indicates the
tolerances in various adjustments and shows that the most crit
is focus adjustment, which must be maintained within ±0.05 mn
if local field variations are to be kept below $\pm 0^{m}\cdot 036$ pg. In ce
tests, local variations, to which irregularities of the photograp
emulsion also contribute, averaged $0^{m}\cdot 050$ in R, $0^{m}\cdot 007$ in G an
$0^{m}\cdot 020$ in U. Those in R showed strong correlation with background density of the panchromatic emulsion; those in U appea
be due mainly to mechanical causes, associated with the natura
smaller photographic star images in U. Standard errors for si
measurements, for stars brighter than 11^{m}, were $0^{m}\cdot 059$ in R,
$0^{m}\cdot 035$ in G and $0^{m}\cdot 047$ in U. Near the plate limit, about 15^{m},
were greater by a factor about 2. Satisfactory calibration of th
plates (by photoelectric measures) requires a good selection of
stars with regard to colour, magnitude and position in field and
is necessary also to calibrate in spectral regions closely simil
to those used in the photography. Not less than 10 stars are ne
per magnitude range. These requirements are not yet met in t
Praesepe region, where U.B.V. magnitudes had to be suppleme
by the photoelectric R magnitudes of Kron et al., pieced out by
corrections based on the Planck radiation formula. Results be
$14^{m}\cdot 0$ are too uncertain for detailed discussion. In the two-col
diagrams K but not G giants were distinguishable from field dw
A and F stars were prominent and the method shows promise i
finding stars with ultra-violet excess. The chief limitation at
present is lack of calibration stars, a defect difficult to remedy
a poor climate.

9281 DEPARTURES FROM THE RUSSELL MODEL IN T
URSAE MAJORIS. R.H.Koch.

Astron. J. (USA), Vol. 66, No. 5, 230-42 (June, 1961).

Yellow, blue, and violet photoelectric light curves have be
obtained for TX UMa. Additional observations place the varia
the U, B, V system. It is demonstrated that the light curve is
variable, at least at certain phases. The outside-eclipse vari
exhibit departures from the Russell model as a function of wav
length of observation. Consistency in the solution of primary
eclipse can be obtained if one abandons the Russell model for
ordinary body eclipse in favour of one comprising two sharp-e
stars, one of which is surrounded by an extensive but sharp-e
atmosphere.

9282 PHOTOELECTRIC MEASUREMENTS OF THE λ52
Fe I TRIPLET AND THE D LINES IN G AND K ST

R.F.Griffin.

Monthly Not. Roy. Astron. Soc. (GB), Vol. 122, No. 3, 181-95 (

A new spectrometer was used at the coudé focus of the Camb
36-inch reflector to measure directly the integrated intensities
features in stellar spectra. The manner in which light is fed
the photomultipliers required careful consideration owing to t
irregular distribution of sensitivity of present-day photocatho
The intensity of the Fe I triplet near λ5250A in G5—K5 stars i
shown to be strongly dependent upon stellar luminosity, and to
related to luminosity and spectral type with little or no intrins
spread. It therefore forms a very favourable luminosity crite
The D lines are relatively insensitive to luminosity, at least u
the late K types; they vary in strength rapidly with spectral ty
the K stars, but their usefulness as a criterion of spectral typ
limited by the large intrinsic scatter among individual objects
The scatter is not correlated with space motions.

9283 OSCILLATION BROADENING OF LINES FROM IONIZED ELEMENTS IN STELLAR SPECTRA.

G.Eriksen.

Nature (GB), Vol. 189, 651 (Feb. 25, 1961).

Draws attention to a Doppler broadening mechanism in w
abrupt disturbances in a plasma cause electrons and ions to
oscillate at or near the Langmuir frequency. The broadening
produced is proportional to the oscillatory velocity of the ele
and to the ratio of ionic charge to mass. K.A.

34 HD 101065 - A G0 STAR WITH HIGH METAL CONTENT.
A.Przybylski.

(GB), Vol. 189, 739 (March 4, 1961).
nis eighth-magnitude dwarf star, classified in the HD cata-
as B5, is found to be much cooler with a K0 continuum and
ner-line spectrum corresponding to class G0. Six-colour
netry indicates anomalous radiation in u.v. and violet regions
eficiencies of +0.08 and +0.06 mag respectively at 3530 and
, but with a normal colour distribution elsewhere in the
um. These results suggest a temperature close to that of
n, and it is suggested that the u.v. anomaly results from the
ting effect of high metal content of the stellar atmosphere.
igh abundance would make the star appear of later type than
pected on the basis of Balmer line-intensities alone. Many
f Ba, Sr and the rare earths appear also: their presence
tes that this star has already passed through the evolutionary
when the heavier elements were formed by slow neutron
ons. It thus poses a similar problem to that of the S stars.
D.R.Barber

85 EXISTENCE OF NET ELECTRIC CHARGES ON STARS. L.Motz; V.A.Bailey.

e (GB), Vol. 189, 994-5, 995 (March 25, 1961).
is pointed out by Motz that the equation relating stellar
ic charge to the Newtonian gravitational constant, and the
of the star, $Q = \beta G^{1/2} M$, where β is a dimensionless
ant equal to 0.33 for the sun (Abstr. 10512 of 1960) is very
y related to a similar equation representing the gravitational
in the interior of protons and electrons by an application of
eyl theory of gauge invariance to the Einstein–Ricci curva-
ensor. This may be expressed in the form, $G^{1/2} = \alpha^{-1/2}\ (e/m)$.
plying the latter equation to the solution of Bailey's solar
, and identifying his constant, β, with $\alpha^{1/2}$, the square root of
ine-structure" constant, $e^2/(hc)$, an equivalent value of β,
sponding to the angular momentum and charge of the sun,
ges from the relation, $\beta = Q/(2I\ \omega c)^{1/2}$. Inserting Bailey's
of Q, and the appropriate value of I, Bailey's value of β is
ed, thus confirming the fundamental similarity between the
asic relationships. Commenting on Motz's result, Bailey
s to a re-computation of his constant, β, that reduces its
from 0.03 to 0.006, and yields a much smaller solar charge
3 × 10^{27} e.s.u. He suggests further the need to obtain an
imental value of β by magnetometer measurements in space-
s moving along different orbits within the interplanetary
etic field.
D.R.Barber

86 A CONTRACTING POLYTROPE IN A MAGNETIC FIELD. A.J.Meadows.

vatory (GB), Vol. 80, 30-1 (Feb., 1960).
he contracting gaseous mass is assumed to pass through
ssive quasi-equilibrium configurations. A poloidal magnetic
could develop from an initially uniform field since the mag-
lines of force would tend to be frozen in the contracting
d region of the polytrope.
R.A.Newing

87 THERMALLY INDUCED CONVECTION IN A STELLAR ATMOSPHERE. R.S.Kushwaha.

Nat. Acad. Sci. India A, Vol. 29, Pt 2, 109-17 (1960).

88 THE GALAXIAN LUMINOSITY FUNCTION.
T.Kiang.

ly Not. Roy. Astron. Soc. (GB), Vol. 122, No. 3, 263-78 (1961).
he discordant results reached by Hubble (1936) and Zwicky
on the form of the galaxian luminosity function are shown to
to observational selection. In a sample of some 600 field
es, regarded as coming from a selection according to the
ent magnitude, the distribution of the residuals from the
ft-magnitude relation is shown to be consistent with a
sity function that varies as x^3 (the cubic) for $0 < x < 3$, and
$^{\cdot 2x}$ (the exponential) for $2.5 < x < 8$, x being the magnitude
he brightest limit M_0. The cubic law is also found to hold
bright cluster galaxies from analyses of "mean clusters"
the magnitude differences among the 10 brightest members
1 of 18 clusters; while the exponential law, originally
ted by Zwicky, is re-affirmed among faint cluster galaxies.
nit M_0 is estimated to be $-22^{m}\cdot 0 - 5 \log(H/100)$; the number
xies in the first 8 magnitudes of the luminosity range is
ted to be 0.46 $(H/100)^3$ per cubic megaparsec; the light
on near 4300 A throughout the luminosity range is estimated
to be the equivalent of 3.7 (H/100) galaxies of $M_{pg} = -15$ per cubic megaparsec, or 7.6×10^{-36} (H/100) ergs^{-1} cm^{-3} A^{-1}; the ubiquitous H being Hubble's constant in km sec^{-1} Mpc^{-1}. These density estimates are uncertain by ±0.15 dex.

9289 COSMICAL ELECTRICAL DISCHARGES.
C.E.R.Bruce.

J. Instn Elect. Engrs (GB), Vol. 4, 669-70 (Dec., 1958).

The author's electrical discharge theory (1944) is outlined with respect to the interpretation of certain astrophysical phenomena; and the process of electrostatic-field generation on stellar, and cosmical scales is described. Observational data are cited as confirmation of the existence of the discharge channels postulated in the theory.
D.R.Barber

9290 COSMICAL ELECTRICAL DISCHARGES. II. SPIRAL STELLAR NEBULAE. C.E.R.Bruce.

J. Instn Elect. Engrs (GB), Vol. 6, 534-6 (Sept., 1960).

In a further note (see preceding abstract) it is pointed out that the electrical discharge theory is alone capable of supplying a satisfactory explanation of the general form, and spectral characteristics of the planetary (stellar) nebulae. Regarding their spectral character, the theory predicts that of the two components (violet and red) of the paired-line spectrum the violet should be the brighter, since this component originates from the nearer of the two diametrically-opposed discharge channels. In 20 such objects whose spectra were measured by Merrill (1932; 1933), only one instance was noted in which the red component was the brighter of the two. In 6 spectra, the paired lines were equally bright; and in the remaining 13 — as theory predicted — the violet component appeared the brighter.
D.R.Barber

9291 SPIRAL STELLAR NEBULAE AND COSMIC GAS JETS.
C.E.R.Bruce.

J. Franklin Inst. (USA), Vol. 271, No. 1, 1-11 (Jan., 1961).

Describes the successful culmination of a search for photographic evidence of the existence of spiral stellar nebulae, initiated by the author's electrical discharge theory of astrophysical atmospheric phenomena, as applied to some types of bright line stars. This theory claims to offer for the first time a satisfactory explanation of the general form and the gas movements observed in planetary nebulae. It elucidates the general nature of cosmic gas jets, concerning which quite erroneous assumptions are made in relation to those in the sun's atmosphere which cause magnetic storms. Applied to galactic nebulae, the theory explains the strange discontinuity recently observed in the gas movements in the barred spiral nebula NGC 1097.

Radioastronomy

9292 THE 140 FOOT RADIO TELESCOPE OF THE NATIONAL RADIO ASTRONOMY OBSERVATORY.

O.Struve, R.M.Emberson and J.W.Findlay.

Publ. Astron. Soc. Pacific (USA), Vol. 72, 439-58 (Dec., 1960).

A description of the instrument under construction at Greenbank, West Virginia, with special reference to performance specifications. A few examples are given of investigations for which such a precise instrument is required.
H.Rishbeth

9293 RADIO EMISSION FROM THE PERSEUS CLUSTER.
P.R.R.Leslie and B.Elsmore.

Observatory (GB), Vol. 81, 14-16 (Feb., 1961).

Observations at 178 and 408 Mc/s give detailed information about three discrete radio sources in the neighbourhood of the Perseus cluster of galaxies; the strongest coincides in position with NGC 1275. The total radio emission is much greater than would be expected if all the cluster members were normal radio emitters.
H.Rishbeth

RADIO-STAR SCINTILLATIONS AND THE AURORAL ZONE. See Abstr. 9195

AMPLITUDE SCINTILLATION OF RADIO STAR AT ULTRA-HIGH FREQUENCY. See Abstr. 9197

9294 AN ATTEMPT TO DETECT LINEAR POLARIZATION IN THE GALACTIC BACKGROUND RADIATION AT 215 Mc/s. J.L.Pawsey and E.Harting.

Austral. J. Phys., Vol. 13, No. 4, 740-2 (Dec., 1960).

An upper limit of 1% is set on the degree of linear polarization in a strip of the southern sky. This conforms with the negative result of Thomson (Abstr. 7 of 1958) but appears to contradict the observations of polarization in the northern sky reported by Razin (Abstr. 6579 of 1958). H.Rishbeth

COSMOLOGICAL SIGNIFICANCE OF ANGULAR MEASUREMENTS OF DISTANT RADIO SOURCES. See Abstr. 9248

Space Research

9295 THEORETICAL EVALUATION OF ATMOSPHERIC DRAG EFFECTS IN THE MOTION OF AN ARTIFICIAL SATELLITE. D.Brouwer and G.Hori.
Astron. J. (USA), Vol. 66, No. 5, 193-225 (June, 1961).

The effect of drag in the gravitational field of an oblate earth is evaluated. A spherical exponential model atmosphere is assumed together with the velocity-square law in drag acceleration. Atmospheric rotation is neglected. The method of canonical transformation is shown to be powerful even in the problem of nonconservative systems like the drag problem. The principal effect of the coupling between the nonsphericity of the earth and air drag is shown to be mixed secular terms and long-period terms produced by short-period terms of the drag-free problem. The result is complete up to the second order in case of secular and mixed secular terms and the first order in case of periodic terms if the drag coefficient A* and the coefficient of the second harmonic of the earth potential k_2 are considered small quantities of the first order. The only exception is with long-period terms in the mean anomaly, for which the result is complete to the order A^*/k_2. The result is complete to the fourth power of the eccentricity in all cases, and is valid for all inclination except the critical inclination case.

9296 A DETERMINATION OF THE ELLIPTICITY OF THE EARTH'S EQUATOR FROM THE MOTION OF TWO SATELLITES. I.G.Izsak.
Astron. J. (USA), Vol. 66, No. 5, 226-9 (June, 1961).

The effect of the most important longitude-dependent term of the geopotential on the motion of artificial satellites is expressed by simple formulae. Its numerical coefficient β can be interpreted as the ellipticity of the earth's equator; the phase constant λ_X gives the geographical longitude of the semimajor axis. Based on photoreduced Baker—Nunn observations of the satellites 1959 $\alpha 1$ and 1959 η, the values of these constants were determined to be

$$\beta = (3.21 \pm 0.29) \times 10^{-5} \text{ and } \lambda_X = -33^\circ\!.15 \pm 0^\circ\!.53.$$

9297 RESONANT ORBITS OF ARTIFICIAL SATELLITES AND LONGITUDE TERMS IN THE EARTH'S EXTERNAL GRAVITATIONAL POTENTIAL. A.H.Cook.
Geophys. J. (GB), Vol. 4, 53-72 (1961).

Contains a preliminary study of orbits with periods bearing some specific relation to the period of the earth's rotation. For the purposes of this study, it is assumed that the eccentricity of the orbit and its inclination to the equator are so small that only the first power of the eccentricity and the square of the inclination need be retained and it is also supposed that, independently of the longitude terms in the potential, the longitudes of the node and perigee change linearly with time. It is found that secular and long period perturbations can arise and that they differ according to the parity of the difference (p-q) for the associated Legendre function $P_q^p(\cos\theta)$ in the spherical harmonic expansion of the potential. One approximate condition for such perturbations is that

$$(q - 1)n = q\omega_r$$

where n is the mean motion of the satellite and ω_r the earth's spin angular velocity. The condition is slightly different for odd and even (p-q). When (p-q) is even, there are perturbations of order e^{-1}) e is the eccentricity of the orbit) in the mean anomaly and the longitude of perigee while when (p-q) is odd there are perturbations of order $(\sin i)^{-1}$ (i is the inclination of the orbit to the equator) in the longitude of the node and of perigee. The simple case of the ellipticity of the equator $(P_2^2(\cos\theta))$ is discussed in rather more detail and some preliminary consideration is given to the problems of the realization of resonant orbits. The general expressions for the perturbations, excluding terms proportional to e^2 and $\sin^4 i$ or of higher order, are given in the Appendix where the complete set of resonance conditions is listed. The resonances discussed in the body of the paper are generally the most important in that they occur for the smallest orbits but there are resonances with smaller orbits in some special cases.

DETERMINATION OF THE ORBITS OF EARTH SATELLITES. See Abstr. 9256

9298 SOME SIMPLE FORMULAS FOR LATITUDE EFF AND LIFETIMES OF SATELLITES. A.Lundbak.
Planet. Space Sci. (GB), Vol. 2, No. 4, 212-13 (Aug., 1960).

An analysis is made of the effect which manifests itself in orbital period of a satellite because of the latitudinal shifting o the perigee. The American satellites Discoverer V and Discoverer VI (both in 1959) offered good opportunities for suc analysis, especially after elimination of the normal aperiodic decrease of the orbital period. Hereby, the latitude effect has turned out to mean deflections in the decrease of the orbital pe about 20% from the average. Some consequences as to air pre and lifetimes of satellites are implied.

9299 MINIMUM RANGE TO ARTIFICAL EARTH SATEL K.Toman.
Nature (GB), Vol. 190, 333-4 (April 22, 1961).

A general expression is derived for the minimum range b a satellite and an observer, including terms which make allow for higher-order effects, and an estimate of the relative magni of these is made. G.M.

9300 THE MOTION OF A SATELLITE IN AN AXI-SYMMETRIC GRAVITATIONAL FIELD. R.H.Mer
Geophys. J. (GB), Vol. 4, 17-52 (1961).

The equations for the variation of the osculating elements satellite are integrated to yield the complete perturbations of first order due to the second harmonic, together with the secu perturbations of the second order due to the second harmonic of the first order due to the third to sixth harmonics. A set of smoothed elements is then derived, in which the perturbations the even harmonics have no singularities, the semi-major axi and eccentricity have no variation due to the second harmonic the other elements have the smallest possible amplitudes of oscillation.

9301 ROTATION PERIOD OF THE ARTIFICIAL SATEL $1958\delta 1$. P.Notni and H.Oleak; C.R.Faulkner.
Nature (GB), Vol. 189, 737-8, 738 (March 4, 1961).

From a consideration of the various factors involved, it concluded that it is not possible to infer evidence of strong wi the upper atmosphere from the observed acceleration of the rotation of $1958\delta 1$ at the end of November 1958, as was done Faulkner (Abstr. 18483 of 1960). In reply, Faulkner points o that he did make allowance for the difference between the obs period of flashing and the true rotation period, so that the pr of finding an explanation of the change remains. The accele seems to have been accompanied by an increased rate of incr of air density. Non-symmetries of shape and weight distribut and the contribution of magnetic damping, are other possible causes. G.M

9302 RADAR ECHOES OBTAINED FROM EARTH SATELLITES 1957 ALPHA AND 1957 BETA.
W.E.Jaye, R.B.Dyce and R.L.Leadabrand.
Planet. Space Sci. (GB), Vol. 5, No. 1, 50-8 (Jan., 1961).

On 16 occasions radar echoes were obtained from the fi Russian earth satellite, 1957 Alpha, by allowing the satellite through the antenna beam, which was aimed at the point of cl approach. Forty-eight echoes were obtained from 1957 Beta largest apparent cross-section being 437 m^2. A median cro section of 1.8 m^2 was obtained. The echo exhibited a cyclic tude fluctuation which was observed to be as low as 0.1 c/s fast as 0.9 c/s. Although calculations indicate that ionosphe Faraday rotation was present in many cases, the amplitude tion of the back-scattered echo generally prevented its ident One occasion is reported of a rapid, irregular amplitude flu imposed on the echo by aurora.

9303 INVESTIGATION OF THE IONOSPHERE AND O THE INTERPLANETARY GAS WITH THE AID C ARTIFICIAL SATELLITES AND SPACE ROCKETS. Ya.L.A
Uspekhi fiz. Nauk (USSR), Vol. 71, No. 3, 369-409 (July, 196
In Russian.

Review, dealing with the reception of radio signals fro and satellites, including Doppler theory; and with the effect satellite on the surrounding medium, with reference to the ing of radiowaves by satellite trails, and to probe experime new experimental results are given. [English translation i Physics—Uspekhi (USA), Vol. 3, No. 4, 479-503 (Jan.-Feb.,
H

TELLITE DETERMINATION OF HEAVY PRIMARY COSMIC-
PECTRUM. See Abstr. 8525

ONEER V MEASUREMENTS OF THE INTERPLANETARY
ETIC FIELD. See Abstr. 9252

ICROMETEORITE IMPACTS TO AN ALTITUDE OF 135 km.
bstr. 9259

9304 IONOSPHERIC SCATTERING OF SATELLITE TRANSMISSIONS. J.Mawdsley and I.R.Richards.
Nature (GB), Vol. 189, 906-7 (March 18, 1961).

Gives a brief critical review of communications concerning the highly aspect-sensitive night-time scintillations of satellite transmissions. A.Boksenberg

PHYSICS

GENERAL

05 THE CONCEPTUAL ASPECT OF DIMENSIONS,
ALLOWING THE LOGICAL INTERPRETATION OF
ATIONS ENCOUNTERED IN THE EQUATIONS OF PHYSICS
NGINEERING. M.Eskenazi.
Tech. Univ. Istanbul (Turkey), Vol. 13, No. 2, 61-8 (1960).
nch.

tempts to give logical justification to operations between
tudes of different dimensions. Multiplication and division of
agnitudes can be considered as a logical conjunction, whereas
on is to be considered as a disjunction. According to this
retation, transcedental expressions correspond to purely
ical values. J.K.Skwirzynski

06 ON THE RELATION BETWEEN THE OLD AND THE
NEW DEFINITION OF THE INTERNATIONAL
E. K.H.Hart and K.M.Baird.
J. Phys., Vol. 39, No. 6, 781-7 (June, 1961).

October, 1960, the Eleventh General Conference of Weights
easures adopted as the new definition of the International
, 1650 763.73 wavelengths in vacuum of the unperturbed
μ line of Kr^{86}. The present paper reports measurements, in
of the new definition, on four copies of the metre which were
nown in terms of the former International Metre prototype.
ndicate no significant discontinuity in the metre, as a result
transition to the new definition, and they demonstrate the
cy to which the metre based on the old definition was
ed in practice.

GRAVITATION . RELATIVITY

7 ON THE TREATMENT OF THE GRAVITATIONAL
FIELD IN CONNECTION WITH THE GENERALLY
IVISTIC DIRAC EQUATION. O.Klein.
ys. (Sweden), Vol. 17, Paper 30, 517-20 (1960).

ggests that the simultaneous quantum theoretical treatment
ravitational field and a fermion field may be simplified if the
ate-dependent γ^{i} and Γ_{i} appearing in the generally relativistic
ation of the Dirac equation are treated as independent
ies. The variation-principle treatment of the gravitational
one by means of the quantities in question is given.
J.K.Skwirzynski

08 COVARIANT QUANTIZATION OF THE GRAVITA-
TIONAL FIELD. J.R.Klauder.
Cimento (Italy), Vol. 19, No. 5, 1059-61 (March 1, 1961).

tention is drawn to the problem of selecting an initial space-
rface in a manifold with no pre-assigned metric. It is
ted that the difficulty could be avoided by adapting a hyper-
ation technique to the gravitational field, and a four-
ional analogue of the Tomonaga–Schwinger equation is
l. R.A.Newing

AN ALTERNATIVE FORMULATION OF THE
LINEARIZED CLASSICAL THEORY OF GRAVITATION
ERO MASS LIMIT. O.Brulin and S.Hjalmars.
s. (Sweden), Vol. 18, Paper 12, 209-17 (1960).

case $R_5(2, 2)$ in Bhabha's classification of relativistic
uations (Abstr. 984 of 1946) is generalized by means of the
previously developed by the authors (Abstr. 329 of 1960).
F.A.E.Pirani

9310 SOME PROPERTIES OF A WORLD-FUNCTION. J.L.Synge.
Colloque sur la Théorie de la Relativite (Brussels, June, 1959) p. 25-35. Louvain: Librairie Universitaire; Paris: Gauthier-Villars.

The method of Hamilton (in optics) could be applied to Riemannian space-time by choosing as characteristic function the geodesic arc-length between points, but a more useful function (on account of its smoothness) is the square of this quantity taken with a positive or negative sign according as the geodesic is time-like or space-like. Some properties of this function are found, and in particular it is shown that the determination of its second covariant-derivatives is essentially the same as that of solving the equation of geodesic variation. C.W.Kilmister

9311 THE GEODESICS IN GÖDEL'S UNIVERSE. S.Chandrasekhar and J.P.Wright.
Proc. Nat. Acad. Sci. USA, Vol. 47, No. 3, 341-7 (March, 1961).

Gödel (Abstr. 7020 of 1950) discovered a solution of Einstein's field equations which, unlike the Friedmann–Lemaitre solutions of relativistic cosmology, is incompatible with Weyl's postulate and does not allow the possibility of defining a universal cosmic time. Here it is shown that the equations for the geodesics with Gödel's metric can be explicitly integrated and that in terms of the explicit solution for the geodesics, many of the properties of Gödel's universe can be more readily understood.
C.W.Kilmister

9312 ON THE GENERAL FORM OF THE SPECIAL THEORY OF RELATIVITY. II. M.Z. v. Krzywoblocki.
Acta phys. Austriaca, Vol. 14, No. 1, 22-8 (1961).

For Pt I, see Abstr. 57 of 1961. Some consequences of the so-called general form of the special theory of relativity, in which the fundamental velocity c is a variable function of position and time, are worked out. For example, the relative velocity formula is unchanged if each velocity is expressed in terms of the appropriate value of fundamental velocity. C.W.Kilmister

9313 DIRECT OBSERVATION OF THE LORENTZ CONTRACTION. J.Ranninger.
Acta. phys. Austriaca, Vol. 14, No. 1, 50-5 (1961). In German.

Simple theoretical discussion of observations of a moving line segment (metre stick) with an ideal pinhole camera.
F.A.E.Pirani

9314 FOUR-DIMENSIONAL CANONICAL FORMULATION OF PARTICLE MECHANICS IN SPECIAL RELATIVITY. E.Schmutzer.
Z. Phys. (Germany), Vol. 162, No. 1, 53-60 (1961). In German.

Difficulties connected with the identity $u_i u_i = -c^2$ satisfied by the 4-velocity u_i, are overcome, in this formulation, by introduction of a projection operator (on the 3-element orthogonal to the 4-velocity) into the definition of canonical momentum (see Abstr. 2103 of 1960). F.A.E.Pirani

9315 RELATIVITY AND ELECTROMAGNETISM: AN EPISTEMOLOGICAL APPRAISAL. H. Dingle.
Phil. Sci. (USA), Vol. 27, 233-53 (1960).

It is argued that the rules of correspondence between physical quantities and the theoretical terms (space and time measurements) in special relativity are inconsistent. [The reviewer disagrees. The equations at the foot of p. 246 are not interpreted in special relativity according to the rules which the author uses.]
Mathematical Reviews (C.W.Kilmister)

9316 CONSERVATION LAWS IN GENERAL RELATIVITY. J.Rayski.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys. (Poland), Vol. 9, No. 1, 33-7 (1961).

It is noted that whereas the covariant equation of continuity for a vector-field leads easily to a conservation law (by Gauss' theorem), the covariance prevents this for the "conservation equation" for a tensor of higher rank. It is proposed to remove this difficulty by expressing the tensor-field in terms of its physical components with respect to a tetrad-field, and a particularly convenient tetrad-field is one in which each vector satisfies the equation of continuity, and is the unit vector in the direction of a gradient, the boundary conditions at spatial infinity being that the tetrad is constant and orthonormal. If the gradients are those of 4 potential functions φ_a, the surfaces φ_a = constant define a coordinate-system which is a natural generalization of an inertial frame. C.W.Kilmister

9317 THE PRINCIPLE OF EQUIVALENCE, NEGATIVE MASS AND GRAVITATIONAL REPULSION.
O.Costa de Beauregard.
C.R.Acad. Sci. (France), Vol. 252, No. 12, 1737-9 (March 20, 1961). In French.

Assuming a negative mass particle to be one for which the passive gravitational mass is equal to the inertial mass, and at least the active gravitational mass to be negative, the well-known results that positive masses attract, negative repel, and unlike ones do either, are proved. Under the additional assumption that the inertial mass is always positive, further results are shown. Most of the later arguments are based on the suspect assumption that anti-particles have negative mass. C.W.Kilmister

9318 HOW TO PASS TO AN EXACT SOLUTION OF EINSTEIN'S VACUUM FIELD EQUATIONS, STARTING FROM A LINEAR APPROXIMATION. J.L.Synge.
Proc. Roy. Irish Acad. A, Vol. 61, No. 5, 37-44 (Jan., 1961).

"Fast" approximation method using retarded potentials and expansion in powers of an arbitrary parameter. A note added in proof points out that the validity of the method remains in doubt until certain convergence properties are proved. (Cf. Abstr. 11790 of 1959). F.A.E.Pirani

9319 GEOMETRODYNAMIC FOUNDATIONS FOR THEORY OF MOTION. J.A.Wheeler.
Rev. mod. Phys. (USA), Vol. 33, No. 1, 63-78 (Jan., 1961).

It is argued that an analysis of the problem of motion must have the following properties: (a) it must start with the initial value data on an initial spacelike hypersurface; (b) it must demand that these data satisfy the initial value equations of Fourès and Lichnerowicz; (c) it must trace out the evolution of the metric and the electromagnetic field in time from the field equations of Maxwell and Einstein; (d) it must do this in such a way as to be able to speak of concentrations of mass-energy under conditions where this concept makes sense; (e) the analysis must not be capable of development in power series with indefinitely high accuracy, otherwise there would be attributed to the concentrations of mass-energy a sharpness of definition which they do not and cannot have. C.W.Kilmister

9320 THE ORIGIN OF CORIOLIS AND CENTRIFUGAL FORCES IN STATIONARY SPACES.
C.Soergel-Fabricius.
Z. Phys. (Germany), Vol. 161, No. 4, 392-403 (1961). In German.

The forces are defined in terms of geodesic motion in the rest-frame of an observer who is at rest in the stationary metric. The connection of fields with sources is established by drawing analogies between Maxwell theory and linearized Einstein theory. The relation of the results to Mach's principle (of relativity of inertia) is discussed. F.A.E.Pirani

9321 EQUATIONS OF MOTION IN THE JORDAN—THIRY THEORY. P.Pigeaud.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1731-3 (March 20, 1961). In French.

A five-dimensional energy tensor is suggested, that leads to the geodesic equation as the equation of motion of uncharged particles. C.W.Kilmister

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

VELOCITY OF LIGHT IN A MAGNETIC FIELD: EXPERIMENTAL POSSIBILITIES FOR DETECTING NONLINEAR QUANTUM MECHANICAL EFFECTS. See Abstr. 9465

9322 COMPLETENESS OF QUANTUM MECHANICS AN CHARGE-CONJUGATION CORRELATIONS OF THETA-PARTICLES. D.R.Inglis.
Rev. mod. Phys. (USA), Vol. 33, No. 1, 1-7 (Jan., 1961).

The "paradox" of Einstein, Podolsky and Rosen (Abstr. 24 1935) is examined by analysis of a two-spin system. Similar siderations apply to a $\theta^0\bar{\theta}^0$ system. P.K

9323 INTERPRETATION OF QUANTUM MECHANICS. II. DETERMINATION OF PROBABILITY OF OCCURRENCE. A.B.Datzeff.
J. Phys. Radium (France), Vol. 21, No. 4, 201-11 (April, 1960). In French.

Taking into consideration previous work (Abstr. 17212 of the exact initial conditions are formulated to which the probab density of occurrence of positions w(x,y,z) of a microcorpuscu μ is subjected. It is shown that the function f(x,y,z) in which $|f|^2 = w$, should satisfy a differential equation of the Sturm—Liouville type. The initial conditions determine its coefficient in a unique way, thus obtaining a probability equation for f, ide to Schrödinger's equation for this case. The following cases a summarized: a problem with two or three dimensions, in case presence of electromagnetic potentials, in the case of depende time, and in the case of numerous corpuscles. In all those ca the corresponding Schrödinger equation is obtained.

9324 CLASSICAL INTERPRETATION OF QUANTUM MECHANICS. J.P Wesley.
Phys. Rev. (USA), Vol. 122, No. 6, 1932-41 (June 15, 1961).

Following de Broglie, Bohm, and others, it is assumed th quantum mechanics may be interpreted causally and that the function plays the role of a generating function for particle tr jectories. By arguing that the ψ function should not be interp a probability amplitude, a new method for generating particle jectories is postulated. The four-momentum of a scalar part assumed to be given as the gradient of an unspecified functio where ψ is a pure real solution of the Klein—Gordon equation the location of a particle is determined solely by its trajecto probability distribution differs from $\psi\psi^*$; and therefore, ordi experimental results differing from the traditional theory ma principle, be predicted. Particle motion and trajectories are cussed for three examples: a free particle, a particle in a bo the double slit.

9325 RELATIVISTIC QUANTUM KINEMATICS. L.M.Garrido.
Rev. Acad. Cienc. Zaragoza (Spain), Vol. 13, No. 2, 197-263 In Spanish.

Elementary exposition without derivations. F.A.E

9326 ON A MANY-DIMENSIONAL B.W.K. APPROXIMA D.H.Secrest and J.O.Hirschfelder.
Proc. Nat. Acad. Sci. USA, Vol. 47, No. 2, 227-40 (Feb., 196

Discusses three possible procedures for making connect between the BWK solutions in the classical and non-classical which are simpler to apply than the standard method, and wh may be useful in many-dimensional applications. J.

9327 FORMAL THEORY OF REARRANGEMENT COLLISIONS. M.H.Mittleman.
Phys. Rev. (USA), Vol. 122, No. 6, 1930-1 (June 15, 1961).

A new formulation of the transition amplitude for the ge rearrangement collision is presented. Optical potential idea used in the derivation but the final result contains no mentio optical potential. The result is a matrix element with transi only between mutually orthogonal states.

STATISTICAL MECHANICS
TRANSFER PROCESSES

28 FUNCTIONAL INTEGRALS AND STATISTICAL PHYSICS.
S.G.Brush.
nod. Phys. (USA), Vol. 33, No. 1, 79-92 (Jan., 1961).
eview. Considers a number of problems (excluding field theory),
can be solved by this technique, and gives a very extensive
graphy. Concludes that no soluble problems have been found
that cannot be dealt with by other methods, but claims that
ethod gives a satisfying physical picture of certain phenomena.
H.N.V.Temperley

29 SOME INTEGRAL EQUATIONS OCCURRING IN THE
CLASSICAL THEORY OF FLUIDS. R.V.Hanks.
ca (Netherlands), Vol. 27, No. 5, 479-89 (May, 1961).
he problem of calculating the pair distribution function in
ical statistical mechanics is approached through an expansion
s function in a new topological parameter. The expansion is
to lead to an infinite set of integral equations, one for each
of the parameter. The first of these equations is examined
ail and is used to derive a new exact integral equation for the
istribution function which incorporates the series rearrange-
of Meeron and Rodemich (1958). A brief discussion of
rical calculations is given.

30 ON STATISTICAL MECHANICS OF NON-EQUILIBRIUM
PHENOMENA. U.Uhlhorn.
Fys. (Sweden), Vol. 17, Paper 13, 193-232 (1960).
n attempt to develop a consistent framework for the descrip-
f non-equilibrium phenomena on the basis of statistical
ical or quantum) mechanics. The phase space is constructed
points are the possible outcomes of an experiment; this
is thus analogous to the phase space of classical mechanics,
composed entirely of macroscopically observable elements.
xperiment phase space is decomposed into ergodic classes
ite measure corresponding to certain "integrals of macros-
motion" (e.g., the macroscopic energy). Each stationary
astic process of the class describes the fluctuations of the
oscopic observables in a given equilibrium state. The phase
structure of an experiment is developed and general properties
s structure are studied (e.g., the reversibility, recurrence and
ach to equilibrium).
J.K.Skwirzynski

31 MACROSCOPIC OBSERVABLES AND GENERALIZED
CANONICAL ENSEMBLES. U.Uhlhorn.
Fys. (Sweden), Vol. 17, Paper 14, 233-55 (1960).
is assumed that certain classes of macroscopic observables
for characterization of macroscopic states in non-equilibrium
odynamics) can be regarded as generators of generalized
ical distributions in a phase space, which may be of the classi-
pe or of a more general nature; thus, physical and mathematical
rties of such generalized canonical distributions are investi-
Basic concepts are introduced, induced probability distribu-
of macroscopic observables discussed and generalized
odynamic relations derived.

32 ON THE FOUNDATIONS OF THE LINEAR THEORY OF
IRREVERSIBLE PROCESSES. I. U.Uhlhorn.
Fys. (Sweden), Vol. 17, Paper 15, 257-72 (1960).
study of the linear phenomenological theory of irreversible
sses—logical structure, possible probabilistic interpretation,
on to statistical mechanics. For an arbitrary system of this
ny initial thermodynamic state may be considered as a
, linear superposition of two states, one giving rise to
y irreversible processes and the other to strictly reversible
sses. The author introduces dissipation functions (e.g., en-
production) which depend only on the state of the system;
istence conditons for such functions are studied.
J.K.Skwirzynski

33 ON THE FOUNDATIONS OF THE LINEAR THEORY
OF IRREVERSIBLE PROCESSES. II. U.Uhlhorn.
ys. (Sweden), Vol. 17, Paper 16, 273-314 (1960).
ontinues with the probabilistic interpretation of the phenome-
cal theory developed in Pt I and with its relation to statistical
nics. The Hilbert space theory of stationary stochastic
ses is extended as a mathematical framework suitable for
tistical description of irreversible processes. This formal structure is analogous to that of the quantum mechanics. A non-deterministic stochastic process, which corresponds to an irreversible physical process, can always be considered as generated by a "purely random" mechanism. The connection between the stochastic process and its generating mechanism is expressed in the form of a "casual representation" of the stochastic process.
J.K.Skwirzynski

9334 STATISTICAL MECHANICAL APPROACH TO NON-EQUILIBRIUM THERMODYNAMICS. U.Uhlhorn.
Ark. Fys. (Sweden), Vol. 17, Paper 19, 343-60 (1960).

Examination of the fundamental approach to non-equilibrium thermodynamics as based on Onsager's work. The following assumptions are examined: time reversal symmetry - fluctuation theory - the assumption that phenomenological macroscopic laws hold also in the range of fluctuations. It is shown that Onsager's reciprocal relations can be derived, without the necessity of introducing particular models, by assuming the validity of time reversal symmetry for observation series in equilibrium systems.
J.W.Skwirzynski

9335 ONSAGER'S RECIPROCAL RELATIONS FOR NON-LINEAR SYSTEMS. U.Uhlhorn.
Ark. Fys. (Sweden), Vol. 17, Paper 20, 361-8 (1960).

These relations are derived on the basis of the time reversal invariance of the mechanical equations of motion and on the assumptions about the behaviour of the transition probability distribution for macroscopically small time differences as expressed by Kolmogorov's condition. J.K.Skwirzynski

9336 FLUCTUATIONS OF PRESSURE.
A.Münster.
Physica (Netherlands), Vol. 26, No. 12, 1117-23 (Dec., 1960).
In French.

Discusses three suggested formulae, and concludes that none of them are strictly valid because a consistent derivation on the basis of statistical mechanics introduces terms that have no precise thermodynamic analogues. No such difficulty occurs for the fluctuations of extensive parameters. H.N.V.Temperley

9337 SOME COMMENTS ON STATISTICAL THERMODYNAMICS. R.Liljeblad.
Asea Res. (Sweden), No. 3, 29-40 (1959).

Makes an attempt to correlate the classical Boltzmann, the Bose—Einstein, and the Fermi statistics. This is made possible by modifying the presentation of the first-mentioned statistics. At the same time, a satisfactory reply is given to the criticism by Loschmidt and others of the inconsistency between the classical Boltzmann theory and the general laws of mechanics. It is also pointed out that the customary usage of the term "particle" for something without identity for the image points in statistical thermodynamics is very misleading. It is therefore suggested that such "particles", i.e. image points, should be considered as singularities in a field.

9338 ON THE STATISTICAL INTERPRETATION OF THE PHENOMENOLOGICAL THEORY OF IRREVERSIBLE PROCESSES. J.P.Guiraud.
C.R. Acad. Sci. (France), Vol. 252, No. 11, 1562-4 (March 13, 1961).
In French.

Further discussion of ideas introduced in Abstr. 16632 of 1960 and generalization of expressions derived there to mixtures of monatomic gases. J.Hawgood

THE STATISTICAL THERMODYNAMICS OF THE APPROACH TO EQUILIBRIUM OF A PLASMA. See Abstr. 9541

THERMODYNAMICS OF IRREVERSIBLE PROCESSES AND THE FORCE EQUATION OF SCHLÜTER. See Abstr. 9542

NON-EQUILIBRIUM THERMODYNAMICS OF SYSTEMS IN AN ELECTROMAGNETIC FIELD. See Abstr. 9668

9339 MAYER'S ENSEMBLES OF MAXIMUM ENTROPY.
A.D.McLachlan and R.A.Harris.
J. chem. Phys. (USA), Vol. 34, No. 4, 1451-2 (April, 1961).

A simple proof, depending upon Lagrange's undetermined multipliers, is given for Mayer's theorem about ensembles of maximum entropy (Abstr. 18976 of 1960). W.J.Orville-Thomas

9340 THERMODYNAMIC FUNCTIONS OF A PARTIALLY DEGENERATE, FULLY IONIZED GAS. H.E.deWitt

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 27-45 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

The formalism of Glassgold, Heckrotte and Watson for the expansion of the quantum-mechanical grand partition function was applied to a gas of point charges. The expansion is shown to be closely related to Rayleigh—Schroedinger perturbation theory, and to give the results of Montroll and Ward in a simpler form. The theory was extended to a multicomponent gas of fermions and bosons and the ring diagrams have been summed to give approximate expression for the equation of state valid for the entire temperature range. The near-classical limit (high temperature and low density so that gas is only slightly degenerate) is discussed in detail, and useful formulae for numerical computation of pressure and internal energy are derived from the general ring approximation to the equation of state. By expanding the chemical potential in powers of the coupling constant e^2, it is possible to eliminate the parametric dependence of pressure and density on the chemical potential and obtain the pressure as a function of density. The classical-limit Debye—Hückel results are obtained when ħ approaches 0. A general form of the screening length is obtained with the effective screening charge as $z_i e \theta_i$, where θ_i is a measure of the degeneracy of the particle species i. The contribution to the pressure from the simplest exchange interaction valid for all temperature is evaluated exactly. The temperature and density range for which the near-classical-limit formulae are valid is discussed.

9341 AN EXTENDED ADIABATIC INVARIANT. S.Tamor.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 4, 199-205 (July, 1960).

The motion of a one dimensional oscillator with time-dependent restoring force is investigated. Consider $\omega(t)$ having one singularity for finite t and such that

$$\lim_{|t|\to\infty}\left|\frac{d}{dt}\,\omega^{-1}(t)\right| = 0.$$

The ratio of ω times the square of the amplitude evaluated at two times, t_1 and t_2 averaged over an ensemble is, in the limit $|t_1|, |t_2| \to \infty$, an adiabatic invariant in the sense that this quantity is not changed by multiplication of ω by a slowly varying function of t. This permits replacement of the actual $\omega(t)$ by a, presumably simpler, $\omega_0(t)$ if their ratio, ω_0/ω is non-singular. Since the orbit equation for a charge in a time-dependent axisymmetric magnetic field is reducible to that of a one-dimensional oscillator it possesses such an invariant. This problem is examined in some detail, particularly for the model field $\omega(t) = \dot{\omega}(t)$. These solutions provide explicit estimates for the energy gained by a charge under a reversal of the magnetic field.

9342 ON THE MOTION OF A CHARGED PARTICLE. I.Prigogine.

Plasma Phys - Accelerators - Thermonuclear Res. (GB), Vol. 2, No. 1-4, 184-7 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

The motion of a charged particle, including the effect of its self field is treated in the frame of classical mechanics by the Liouville method, developed recently by the author and his co-workers mainly for statistical mechanical problems. The author summarizes the results which he and Leaf have obtained in this way for the following cases: (a) free particle in vacuum (b) free particle in a black body (c) harmonic oscillator. In every case the partial differential equation giving the evolution of the particle phase distribution function is established.

9343 A NOTE ON THE RELATIVISTIC BOLTZMANN EQUATION AND SOME APPLICATIONS. S.Yadavalli.

J. Franklin Inst. (USA), Vol. 271, No. 5, 368-75 (May, 1961).

Starting from the Boltzmann equation in the proper frame, the relativistic version of the equation in the absence of collisions is derived. As an application, a simple example of a velocity modulated drifting relativistic electron beam in the presence of a velocity distribution is treated.

QUANTUM STATISTICAL DERIVATION OF THE MACROSCOPIC MAXWELL EQUATIONS. See Abstr. 8372

9344 THREE BODY COLLISIONS IN QUANTUM MECHA P.Resibois.

Physica (Netherlands), Vol. 27, No. 1, 33-47 (Jan., 1961).

The Prigogine diagram technique is used to study this pro the transition probability is derived as an expansion in terms "binary kernels" which describe two-body collisions between intermediate states. The low-energy hard sphere case is solv approximately.

J.Ha

9345 LONG-RANGE CORRELATIONS IN A CLOSED SYS WITH APPLICATIONS TO NONUNIFORM FLUIDS.

J.L.Lebowitz and J.K.Percus.

Phys. Rev. (USA), Vol. 122, No. 6, 1675-91 (June 15, 1961).

Corrections are investigated to the representation of the j distribution of q + l particles, n_{q+l}, by the product $n_q n_l$ for la separation between the sets of q and l particles. For a system which there exists a "finite correlation length," the 1/N correc term to the simple product is found explicitly, where N is the number of particles in the system. When q + l is equal to two, expression reduces to that familiar from the Ornstein—Zernik relations for scattering of light from a fluid. In a uniform gas derivation also yields the explicit 1/N dependence of equilibriu distributions. The result on the asymptotic form is then used determine the low-order distribution functions for an equilibri system of varying density, as well as for a nonequilibrium sys represented by a local-equilibrium ensemble. These distribut functions are shown to be governed by the temperature and den in the vicinity of the molecules considered. It is found as expe that the two-body distribution function coincides, to within qua terms in the gradients, with its equilibrium value for a unifor system at the temperature and density of the midpoint. For th higher-order distributions, correction terms linear in the gra are found.

9346 DYNAMICS OF CLASSICAL MANY-BODY SYSTE E.P.Gross.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. No. 1-4, 173-83 (Jan., 1961). [Proceedings of the 1959 Interna Plasma Physics Institute].

The present state of the theory of the propagation of sma amplitude disturbances in monatomic gases and plasmas is fi discussed. The analysis is based on kinetic equations for one velocity distributions involving self-consistent field forces an Boltzmann-like collision terms. Then a microscopic formula the classical N-body problem is developed. The theory is use analyse the meaning of earlier microscopic approaches, and to the point where the problem can be treated in a more funda way.

9347 ON PHASE SEPARATION IN AN ISOTOPIC MIXTU OF A HARD SPHERE BOSE AND FERMI GAS.

E.G.D.Cohen and J.M.J.van Leeuwen.

Physica (Netherlands), Vol. 26, No. 12, 1171-3 (Dec., 1960).

A simple theory of a mixture of ideal gases is set up, on lines laid down for pure gases by Huang, Lee and Yang in a se of papers, see, for example Abstr. 4300 of 1959. The formal of the interaction terms is to lead to the prediction of phase separation. The predicted phase-separation curve and variat λ-point with concentration agree very well with experiments He^3—He^4 system. The theory does not claim to be more than preliminary and further developments are promised.

H.N.V.Te

9348 PERTURBATIVE TREATMENT OF PAIRING FO IN MANY-FERMION SYSTEMS. M.Bolsterli.

Phys. Rev. (USA), Vol. 122, No. 6, 1946-8 (June 15, 1961).

A noncanonical transformation which allows perturbative techniques to be applied to the pairing force problem is intro The lowest order eigenvalue equation gives the standard resu both strong and weak coupling.

9349 APPROXIMATE METHODS IN THE QUANTUM T OF MANY-FERMION SYSTEMS. R.K.Nesbet.

Rev. mod. Phys. (USA), Vol. 33, No. 1, 28-36 (Jan., 1961).

The treatment of many-fermion systems, starting from determiniantal wave-function of single-particle orbitals, is d In particular, three ways of determining the single-particle are introduced and compared: in the "unrestricted" Hartree method the energy is minimized subject to arbitrary variati the orbitals; in the "traditional" Hartee—Fock method all th containing a given irreducible representation of the rotating have the same radial function, which is determined by minim

rgy as before; and in the method of "symmetry and
ence restrictions" matrix elements of the effective one-
e Hamiltonian between different irreducible representations
ored. The three methods are effectively the same for closed
but differ for open shells when, in general, the first and
ethods give degenerate solutions. The removal of this
racy gives rise of "collective" modes. Some generalizations
methods, to include the effects of certain correlations are
sed. E.J.Squires

50 ON THE FUNDAMENTAL EQUATIONS OF INVARIANT IMBEDDING. I. R.Bellman and R.Kalaba.
Nat. Acad. Sci. USA, Vol. 47, No. 3, 336-8 (March, 1961).
is shown that the type of non-linear equation for external
sually obtained by particle-counting techniques in the invariant
ding approach to transport theory can be derived rigorously
he linear internal transport equations, in a one-dimensional
nvolving two different types of particles. See Abstr. 16616
004-5 of 1960. J.Hawgood

51 GENERALIZED INVARIANT IMBEDDING RELATION. R.W.Preisendorfer.
Nat. Acad. Sci. USA , Vol. 47, No. 4, 591-4 (April, 1961).
resents a generalization, to its most symmetric form for one-
eter spaces, of the precise analytic version of the invariant
ding relation given by the author (Abstr. 7436 of 1958). The
ed form of the mapping operator possesses the group property.
J.Hawgood

52 IRREVERSIBLE PROCESSES IN GASES. III. INHOMOGENEOUS SYSTEMS. I.Prigogine and R.Balescu.
ca (Netherlands), Vol. 26, No. 3, 145-9 (March, 1960).
or Pts I-II, see Abstr. 10614-15 of 1960. The technique of
g an asymptotic solution of Liouvilles' equation by formal
ion and classifying the terms by means of diagrams is
alized further. It is claimed that the results reveal a
cteristic difference between the approach to equilibrium of
geneous and inhomogeneous systems. H.N.V.Temperley

53 ON THE DECAY OF LONG-RANGE CORRELATIONS. I.Prigogine, R.Balescu and I.M.Krieger.
ca (Netherlands), Vol. 26, No. 7, 529-30 (July, 1960).
he method developed by Prigogine and Balescu (preceding
act) is applied to the time variation of the two-particle
bution function at large separations of the two particles. For
y coupled systems a closed equation is obtained. This may
applications to turbulence. O.Penrose

GENERAL MECHANICS

54 MEASUREMENT OF THE DYNAMIC MODULUS OF SURFACE FILMS. G.W.Becker and K.Frankenfeld.
ca (Internat.), Vol. 10, No. 2, 127-8 (1960). In German.
escribes simple apparatus for determining the flexural
ons under different loading and temperature conditions of a
strip coated with lacquer 25-50 μ thick. The vibrations are
l with an RC oscillator and detected with an inductive system
ng a bridge circuit. The complex elastic modulus of the
 material can be derived from the resonance vibrations of a
aving a coating of the same thickness on each side of it.
H.J.H.Starks

55 AN EXACT SOLUTION IN FINITE STRAIN. G.Lakshminarayana and B.Kesava Rao.
Nat. Acad. Sci. India A, Vol. 29, Pt 3, 291-6 (1960).
e stress—strain problem of an incompressible spherical
s solved in terms of the strain energy function. The results
plied to a neo-Hookean solid and numerical displacement data
oted. J.K.Skwirzynski

MECHANICAL MEASUREMENTS

9356 THE DESIGN AND CONSTRUCTION OF A DEVICE FOR RECORDING SMALL DISPLACEMENTS.
P.R.James.
Mag. Concrete Res. (GB), Vol. 13, 37-9 (March, 1961).

Describes the design and construction of an electro-mechanical device for remote, continuous recording of displacements of the order of one millimetre. It can be applied to the recording of the relative movement of sections of concrete road on either side of an expansion joint. It consists of an electronic potentiometer recorder in conjunction with a bridge circuit of four resistance strain gauges, the variation in out-of-balance potential being used as a measure of displacement.

9357 MEASUREMENT OF THE THICKNESS OF THIN FOILS. G.M.Osetinskii and M.V.Savenkova.
Pribory i Tekh. (USSR), 1959, No. 6, 114-16 (Nov.-Dec.).
In Russian.

The thickness of thin foil windows for gas target applications was measured in terms of the sharp fall off in absorption of Po^{210} α-particles at the end of their range. The foils were introduced into a vacuum chamber between a polonium source and a ZnS crystal with photomultiplier detector. The particle count taken at various air pressures in the range 100-760 Torr was plotted with and without the foil in position to obtain complete absorption curves. The displacement of the curves in terms of differences in air pressure (at half height) could be interpreted directly in terms of the equivalent foil density in mg/cm^2. The apparatus was used for nickel foils from 0.8 to 1.5 μ (0.9-1.6 mg/cm^2). The achievable accuracy was investigated by comparison with weighed samples and was estimated to be of the order of 1.5% for foils of similar thickness to a standard and 3-4% if samples are of considerably different thickness. [English translation in: Instrum. exper. Tech. (USA), No. 6, 971-3 (Nov.-Dec., 1959; publ. Sept., 1960)]
W.Steckelmacher

9358 MEASURING THE THICKNESS OF THIN CELLULOID FILMS.
I.S.Dmitriev, Ya.A.Teplova, V.S.Nikolaev and L.N.Fateeva.
Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 131 (Nov.-Dec.).
In Russian.

A photometric method was developed for measuring the thickness of organic films in the range 2-20 μg/cm^2. Although their light-absorption coefficient is so small, use was made of the effects of interference in reducing considerably the transmitted intensity: the transmitted intensity first falls with increasing thickness of the film, reaching a minimum at about 0.1μ thickness, after which it begins to rise again and vary periodically. In addition, the colour of the reflected light gives a guide to the particular absorption cycle corresponding to the measured intensity, thus eliminating indeterminacy. A formula relating the transmitted intensity to the incident intensity in terms of film thickness, refractive index, absorption coefficient, and illumination wavelength is given. [English translation in: Instrum. exper. Tech. (USA), No. 6, 987-8 (Nov.-Dec., 1959; publ. Sept., 1960)].
R.V.Coates

9359 INTERFERENCE COMPARATOR FOR THE CALIBRATION OF LINE STANDARDS DIRECTLY IN TERMS OF STANDARD WAVELENGTHS. K.M.Baird.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 549-54 (May, 1961).

An interference comparator was built for the routine calibration of line standards or scales by direct reference to the vacuum wavelength of the 0.606 μ line of Kr^{86} which recently became the international standard of length. The principles of construction and the performance of the comparator are given; it is shown to yield an accuracy of calibration which is mostly limited by the nature of present-day line standards or scales, viz., a few hundredths of a micron in lengths up to one metre.

9360 POSSIBLE APPLICATIONS OF OPTICAL INTERFERENCE IN THE TECHNICAL ASPECTS OF SURFACE MEASUREMENT. H.Trumpold.
Wiss. Z. Hochsch. Maschinenbau Karl-Marx-Stadt (Germany), Vol. 2, No. 1, 59-71 (1961). In German.

Review of interference microscopy especially as applied in engineering technology for surface finish studies. The extension of interferometry to equidensity methods and also the application of immersion techniques are reviewed. S.Tolansky

SMEAR CAMERA TECHNIQUES FOR FREE-SURFACE VELOCITY MEASUREMENT. See Abstr. 9497

9361 OXYGEN GAUGE. J.Weissbart and R.Ruka.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 593-5 (May, 1961).

A high temperature galvanic cell which measures oxygen partial pressure is described. Quantitative measurements in the region 1 to 10^{-5} atm show a nearly linear relationship between the cell e.m.f. and the logarithm of the oxygen pressure at temperatures between 600° and 750°C. The cell can measure oxygen pressures in vacuum systems as well as in flowing gas mixtures.

9362 FABRICATION OF PYREX SPIRAL BOURDON GAUGES. J.D.Ray.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 600-1 (May, 1961).

9363 FREQUENCY MEASUREMENT OF STANDARD FREQUENCY TRANSMISSIONS. S.N.Kalra.
Canad. J. Phys., Vol. 39, No. 5, 778 (May, 1961).

9364 FREQUENCY MEASUREMENT OF STANDARD FREQUENCY TRANSMISSIONS. S.N.Kalra.
Canad. J. Phys., Vol. 39, No. 6, 956 (June, 1961).

Measurements made at Ottawa, Canada, using N.R.C. caesium-beam frequency resonator as reference standard (with an assumed frequency of 9 192 631 770 c/s).

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

9365 HYDROSTATIC METHOD OF MEASURING THE COMPRESSIBILITY OF A LIQUID UNDER HIGH PRESSURE. A.D.Ekhlakov and K.P.Rodionov.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 932-5 (June, 1960). In Russian.

The method is based on the change in weight of a solid body immersed in the liquid. Data are given for the density of kerosene, transformer oil and 25, 50 and 75% mixtures of the two between 20 and 80°C and at pressures up to 5000 kg/cm². R.F.S.Hearmon

9366 BASIS OF VERIFICATION OF METAL AND GLASS SIKES HYDROMETERS. P.H.Bigg.
J. sci. Instrum. (GB), Vol. 38, No. 6, 235-8 (June, 1961).

The basis of verification was refined as the outcome of discussions between the Laboratory of the Government Chemist and the National Physical Laboratory. The refinement takes the form of the adoption of conventional reference conditions for the wetness of the hydrometer stem above the liquid surface and the surface tension pull acting on it. Corresponding refinement in the reference conditions associated with the glass hydrometers was adopted by the N.P.L. These refinements lead to greater consistency in verification and do not affect the ordinary calibration of Sikes hydrometers, except for glass hydrometers used in very dilute solutions. Full details for the precise verification of both metal and glass Sikes hydrometers are given.

9367 EFFECT OF DISSOLVED AIR ON THE VISCOSITY OF WATER. W.A.Caw and R.G.Wylie.
Nature (GB), Vol. 189, 995-6 (March 25, 1961).

The viscosity of air-saturated water was measured relative to that of air-free water, the temperature being controlled to within ±0.0007°C. Within a set, the flow-times agreed within 1 part in 50 000. The effect of air at atmospheric pressure on the kinematic viscosity of water does not exceed 13 parts in 10^6 at the 95% confidence level. This relates to the combined effects of the dissolved air and the pressure. The direct effect of the pressure of 1 atm is to change the viscosity by no more than a few parts in 10^6. These investigations were made at 20, 25, and 30°C. R.Schnurmann

9368 VISCOSITY DIFFERENCE MEASUREMENTS FOR NORMAL AND PARA LIQUID HYDROGEN MIXTURES. R.Webeler and F.Bedard.
Phys. of Fluids (USA), Vol. 4, No. 1, 159-60 (Jan., 1961).

The piezoelectric alpha quartz torsional oscillator technique (Abstr. 152 of 1958) was used to measure differences in ortho-para concentrations. At 39 702 c/s the $\eta\rho$ values below 14.5°K for 69% ortho liquid hydrogen are about 4% larger than the corresponding values for 28% ortho liquid hydrogen. The ortho—para concentration was determined during the various stages of the conversion process by measuring the temperature of the triple point.
R.Schnurmann

9369 CIRCULATION PRESERVING MOTIONS. A.C.Srivastava.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1337-8 (July, 1960).

Two theorems concerning circulation preserving motions a stated and proved. Two particular examples to illustrate them also given. It is deduced that two circulation preserving motion in a Newtonian fluid when their sum is circulation preserving a mutually superposable but in a non-Newtonian fluid this propos is true only if one more condition is satisfied. Similar results were deduced for self-superposability also.

9370 HYDRODYNAMICAL APPLICATIONS OF A THEORE ON SPHERICAL MEANS. E.Jabotinsky.
Bull. Res. Coun. Israel, Vol. 9C, No. 1-2, 57-60 (Feb., 1961).

A theorem on vectorial spherical means is applied to the angular momentum theorem for a spherical volume completely immersed in a laminar flow. The resulting formula yields direc classical results for perfect fluids and shows that rot rot rot v i indicator of magnitude of the moments of shear and thus possibl also of the conditions for the inception of turbulence.

9371 ON THE QUASI-TWO-DIMENSIONAL LAMINAR BOUNDARY LAYER. N.Hayasi.
J. Phys. Soc. Japan, Vol. 15, No. 1, 208-9 (Jan., 1960).

It is intuitively obvious that when the three-dimensional laminar boundary-layer equations are expressed in streamline coordinates, they will reduce to those appropriate to an axi-symmetric boundary layer if the geodesic curvatures of the stre lines on the body surface are small. The author indicates this b direct reference to the relevant equations. N.C

9372 ON SIMILAR SOLUTIONS OF THE STEADY QUASI- TWO-DIMENSIONAL INCOMPRESSIBLE LAMINAR BOUNDARY-LAYER EQUATIONS. N.Hayasi.
J. Phys. Soc. Japan, Vol. 15, No. 3, 522-7 (March, 1960).

Using the orthogonal curvilinear coordinates, three-dimens incompressible laminar boundary-layer equations are obtained. These equations reduce to two-dimensional type, if one compo of the velocity and the pressure gradient in that direction are negligible throughout the boundary layer. Conditions for the existence of similar solutions for such quasi-two-dimensional ary layers are investigated. New similar solutions are found "planar coordinates" α, β, γ ($\gamma = 0$ gives the surface) in the where the velocity at the outer edge of the boundary layer is expressed as $\{B_1G(\alpha,\beta) + B_2\}^m$ or $B_2 \exp\{B_1G(\alpha,\gamma)\}$, where is a constant, B_1 and B_2 are arbitrary functions of β, and $G(\alpha,$ is a known function determined by the surface geometry.

9373 VARIATIONS AND TURBULENCE OF A VORTEX CONTAINING A COLORANT. C.Camichel.
C.R. Acad. Sci. (France), Vol. 252, No. 4, 483-6 (Jan. 23, 1961 In French.

A study of vortex motion at varying speeds and with variou types of colorant. There is an excellent set of photographs of vertical section of the vortices under various conditions.
T.C

9374 THEORY OF THE SURFACE TENSION OF MOLTE SALTS. H.Reiss and S.W.Mayer.
J. chem. Phys.(USA), Vol. 34, No. 6, 2001-3 (June, 1961).

A theory of the surface tension of molten salts is presente based on a result obtained by Reiss, Frisch, Helfand, and Leb (Abstr. 3507 of 1960) and a theory of corresponding states. This theory allows one to compute the surface tension of a salt the diameters of the ionic hard cores are known along with the densities of the salts at a given temperature. Agreement with experiment is very good.

9375 THE VELOCITY OF ASCENT OF GAS BUBBLES I LIQUIDS OF VARYING VISCOSITY AND SURFACE TENSION. E.Coester.
Z. angew. Phys. (Germany), Vol. 13, No. 5, 254-9 (May, 1961).

The velocity of ascent of air bubbles was studied in glycer and in water. The velocity increased at first with the volume a tended then towards a constant value. The air bubbles were practically spherical in the range for which the velocity increa with their volume. Larger bubbles were of an oblate shape. T spherical gas bubbles encountered a smaller resistance than r spheres of similar volume. For small Reynold's numbers the resisting force was only two-thirds of the Stokes value. A dimensional analysis was made for the purpose of deriving an equation which can be applied to estimate the velocity of ascen gas bubbles in any liquid. R.Schnur

376 LIQUID PUMPING APPARATUS FOR USE IN STUDYING FAST CHEMICAL REACTIONS.

Weiss and C.W.Urmy, Jr.

sci. Instrum. (USA), Vol. 32, No. 5, 586-8 (May, 1961).

A versatile pump apparatus is described which is capable of dly pumping small quantities of two dissimilar liquids at me ratios varying from one to one to about three to one. For conditions described herein, pumping times of the order of iseconds were obtained for delivery volumes varying between d 3 ml. of liquid per pump. The pentaborane—methanol tion is used to demonstrate the reliability of this apparatus to show an application to fast chemical reactions.

LIQUID STATE

(Liquid helium is included under Low-Temperature Physics)

377 ON THE STRUCTURE OF FERRIC CHLORIDE SOLUTIONS. C.L.Standley and R.F.Kruh.

em. Phys. (USA), Vol. 34, No. 4, 1450-1 (April, 1961).

Approximate interpretations made from diffraction measure- s on a series of solutions of ferric chloride in HCl suggest the iron is tetrahedrally coordinated by the chlorine. The lts do not support the octahedral cage suggested by Brady tr. 1146 of 1959). G.I.W.Llewelyn

378 X-RAY DIFFRACTION STUDY OF LIQUID MERCURY—INDIUM ALLOYS.

ng Soo Kim, C.L.Standley, R.F.Kruh and G.T.Clayton.

hem. Phys. (USA), Vol. 34, No. 4, 1464-5 (April, 1961).

It was shown that the first peak in the radial distribution tions is almost symmetrical and can be explained by assuming same pair distribution to exist over the whole composition e. T.C.Toye

379 PHENOMENOLOGICAL FORMULATION OF THE PRINCIPLE OF CORRESPONDING STATES FOR LIQUIDS SISTING OF CHAIN MOLECULES. J.Hijmans.

sica (Netherlands), Vol. 27, No. 5, 433-47 (May, 1961).

The principle, developed by Prigogine et al. (Abstr. 5713 of 1957), eformulated from a phenomenological point of view. The princi- s obtained from a set of assumptions, without making use of er the quasi-lattice hypothesis or the cell-model for the liquid e. The molecular units required for reducing the various thermo- mic quantities depend on three characteristic molecular para- ers, each of which has the significance of an effective number of nents per molecule. The predicted linear dependence of these meters on chain length is confirmed by the thermodynamic data e normal alkanes.

380 IMPROVEMENTS IN THE LATTICE MODEL OF A LIQUID. H.N.V.Temperley.

. Phys Soc. (GB), Vol. 77, Pt 3, 630-42 (March, 1961).

A new type of approximation is introduced, with the objects of ining further the transition of a fluid of non-attracting rigid ecules, and of improving the lattice model of a liquid by reducing atio of mesh size to molecular volume. The approximation is checked by applying it to some simple two-dimensional lattices, oducing many known results and predicting some new ones. The ably qualitative behaviour of the isotherm of a two-dimensional of rigid non-attracting molecules is determined, available ence suggesting the existence of a finite region in which the fluid e is metastable. Some preliminary results on the effect of cing the lattice mesh size suggest that simple lattice models of uid do give physically sensible results in spite of their crudity.

381 THE HOLE THEORY OF LIQUIDS. J.Grindlay.

. Phys. Soc. (GB), Vol. 77, Pt 5, 1001-4 (May, 1961).

It is shown that the partition function occurring in the hole y of liquids may be expressed in closed form by means of the i-chemical approximation alone. The thermodynamic erties of this form are described. It is concluded that this y fails to provide a satisfactory description of the critical of the liquid state.

LONG-RANGE CORRELATIONS IN A CLOSED SYSTEM H APPLICATIONS TO NONUNIFORM FLUIDS.
Abstr. 9345

9382 THE THERMAL CONDUCTIVITIES OF NORMAL- AND PARA-HYDROGEN AT 20°K. K.Heizinger.

Z.Naturforsch. (Germany), Vol. 15a, No. 11, 1022 (Nov., 1960). In German.

A differential method was used and the value 1.0057 ± 0.0007 was obtained for the ratio of the thermal conductivities. S.Weintroub

9383 ON DYNAMIC EQUATIONS OF STATE FOR LIQUIDS WITH SPECIAL REFERENCE TO VERY VISCOUS MATERIALS. L.Rothhardt.

Z. phys. Chem. (Germany), Vol. 216, No. 1-4, 1-6 (1961). In German.

Various combinations of springs and dash-pots are often used to represent the propagation of ultrasonics in liquids. Markham, Beyer, and Lindsay (Abstr. 4971 of 1952) suggested that very viscous liquids presented a particularly simple picture. However, experiments on the hydrolysis of silicic acid esters show that the absorption and velocity of ultrasonics remained constant within 3%, while the viscosity changed from 10^{-2} to 10^{2} P and the system finally solidified. R.Schnurmann

9384 MEASUREMENT OF VOLUME CONTRACTION AND HEAT OF MIXING OF OXYGEN—NITROGEN MIXTURES.

C.M.Knobler, H.F.P.Knaap and J.J.M.Beenakker.

Physica (Netherlands), Vol. 26, No. 2, 142 (Feb., 1960).

Preliminary report of measurements on volume contraction and heat of mixing given in graphical form. Maximum value of heat of mixing in reasonable agreement with that from vapour pressure measurements. F.E.Hoare

9385 QUANTUM EFFECTS IN THE LIQUID STATE BY MEANS OF A PHENOMENOLOGICAL CELL MODE: THE VAPOUR PRESSURE RATIO OF Ne AND Ar ISOTOPES.

R.Fieschi and N.Terzi.

Physica (Netherlands), Vol. 27, No. 5, 453-64 (May, 1961).

Quantum effects on the vapour pressure of argon and neon isotopes in the liquid state are evaluated by means of two semi-empirical cell models. The space arrangements of atoms around the cell is obtained through the experimental data on the radial distribution function; the energy levels of the oscillators, appearing in the quantum partition function, are calculated in the anharmonic approximation. At $T = T_{tr}$ the results are higher than the theoretical results for the solid, while they should be lower. This comparison points out the limits of lattice-cell models even at high densities, in spite of the fact that some agreement is found with the experimental data.

9386 QUASI-ELASTIC SCATTERING OF COLD NEUTRONS BY WATER AND COEFFICIENT OF SELF DIFFUSION OF THE LIQUID. D.Cribier and B.Jacrot.

J. Phys. Radium (France), Vol. 21, No. 1, 69-71 (Jan., 1960). In French.

The inelastic scattering of cold neutrons in water was investigated at 30° and 43°C. From observations of the full width of the scattered spectra the values of 2.67×10^{-5} and 3.4×10^{-5} cm^2 sec^{-1} for the coefficient of self-diffusion (D) were obtained at 30° and 43°C, respectively. These values are in good agreement with those found by others using nuclear magnetic resonance techniques. J.B.Garg

DELINEATION OF THE PROBLEM OF SORET DIFFUSION.
See Abstr. 8913

9387 SOLUBILITY OF METALS IN MERCURY. V.P.Gladyshev.

Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 852-60 (June, 1960). In Russian.

In a general discussion of the solubility, S, of various metals in Hg, it is shown that in the case of simple, binary amalgams containing only one metal in solution, there is a definite relationship between S and the following properties of metals: the structure of the inner electron shells; energy of the atomic bond in the crystal lattice; the magnitude of the first ionization potential and of the generalized moment of metal ions; structure of liquid metals. The causes of the anomalous behaviour of certain metals (Na, Ba) and the relationship between increased S of metals in the A1 sub-group and their atomic structure are also discussed. M.H.Sloboda

9388 THEORY OF SOLUTIONS. III. THERMODYNAMICS OF AGGREGATION OF POLYMERIZATION. T.L.Hill.

J. chem. Phys. (USA), Vol. 34, No. 6, 1974-82 (June, 1961).

For Pt II, see Abstr. 3209 of 1959. Polymeric and colloidal systems are usually polydisperse, containing possibly hundreds or thousnads or more, of subspecies differing only in degree of polymerization n. The required thermodynamic approach is that appropriate to a highly multicomponent system. Let P(n) be the fraction of polymer molecules of size n. The distribution function P(n) will depend on one or more parameters, for example, the mean $\bar{n}$ and standard deviation σ in the case of a Gaussian distribution. The thermodynamic problem becomes tractable if one replaces, as composition variables, the numbers of molecules of all the polymer subspecies by the total number of polymer molecules N and the parameters of P(n). The new set of variables may be only two, three, etc., in number. The main interest in this paper is to investigate how the thermodynamic functions of the system change when the distribution function P(n) changes, as, for example, in a kinetic study in which P(n) envolves sufficiently slowly with time or in thermodynamic studies on different samples of the same polymer.

9389 VELOCITY OF SOUND AND MOLECULAR STRUCTURE. I. A GENERAL POINT OF VIEW ON MOLECULAR KINETIC THEORY CALCULATIONS OF THE VELOCITY OF SOUND IN LIQUIDS.

K.Altenburg.
Z. phys. Chem. (Germany), Vol. 216, No. 1-4, 126-38 (1961).
In German.

Calculations of the velocity of sound in liquids can be made using the kinetic theory of gases or crystals. Both methods are used in simple cases and the limitations of both approximations discussed. T.E.Peacock

9390 VELOCITY OF SOUND AND MOLECULAR STRUCTURE. II. ON THE TEMPERATURE DEPENDENCE OF THE VELOCITY OF SOUND.

K.Altenburg.
Z. phys. Chem. (Germany), Vol. 216, No. 1-4, 139-45 (1961).
In German.

For Pt I see preceding abstract. It is shown that the reduced temperature coefficient of the velocity of sound

$$G = \frac{\Delta u}{\Delta T} \cdot \frac{T_K}{u_0}$$

(u_0 is the velocity of sound at 0°K and T_K the absolute critical temperature) is a linear function of R_D, the molar refraction. G is plotted against R_D for 41 different organic liquids. T.E.Peacock

9391 VELOCITY OF SOUND AND MOLECULAR STRUCTURE. III. THE VELOCITY OF SOUND AND THE INTERMOLECULAR POTENTIAL ENERGY.

K.Altenburg.
Z. phys. Chem. (Germany), Vol. 216, No. 1-4, 146-62 (1961).
In German.

For Pt II see preceding abstract. The Newtonian model for the propagation of sound in liquids is considered. The influence of the structure of the liquid leads to a relationship between the intermolecular potential energy and the velocity of sound. The agreement between theoretical and experimental values for the velocity of sound in H_2 and He is fairly satisfactory. It is shown that the intermolecular repulsion part of the potential energy is a linear function of the number of valence electrons in the molecule. T.E.Peacock

9392 ULTRASONIC ABSORPTION MEASUREMENTS IN SOME PURE LIQUIDS.

H.S.Rama Rao and B.Ramachandra Rao.
Current Sci. (India), Vol. 29, No. 12, 467 (Dec., 1960).

An experimental technique for the measurement of ultrasonic absorption in corrosive liquids is described. Results are tabulated for phosphorus oxychloride and for a series of esters, and it is observed that the experimental values (i) are all higher than the theoretical values, and (ii) vary with frequency. G.I.W.Llewelyn

9393 DETERMINATION OF ABSORPTION COEFFICIENT AND REFRACTIVE INDEX OF COLLOIDAL GOLD.

H.Römer and C.v.Fragstein.
Z. Phys. (Germany), Vol. 163, No. 1, 27-43 (1961). In German.

By means of Mie scattering theory it is shown that (n − ik) can be found from two measurements, (a) the transmission of a dilute sol and (b) its refractive index, by simple formulae if the particles are very small compared with the wavelength of the light. The former was measured in the usual way by spectrophotometry, the latter by means of a Rayleigh refractometer compensated for use with absorbing media. Results are given for particles in the size range 30 to 300 A diameter, wavelength range 4300 to 6400 A; a comparison is made with the results of other workers for thin films and for massive gold. W.T.Welford

REFRACTOMETER MEASUREMENTS OF SOME MEDICINAL SUBSTANCES. See Abstr. 9469

THEORY OF THE OPTICAL ACTIVITY OF POLYMER SOLUTIONS. See Abstr. 9487

9394 CALCULATION OF THE INTENSITY AND THE BREADTH OF INFRARED BANDS IN LIQUIDS FROM DISPERSION MEASUREMENTS.

M.Cameo and J.Vincent-Geisse
C.R. Acad. Sci. (France), Vol. 252, No. 11, 1579-81 (March 13, 19
In French.

Describes a classical damped-oscillator calculation, which u measurements reported in Abstr. 5241 of 1957; 7698 of 1961, of dispersion in and near strong bands in CCl_4, $CHCl_3$, $C_2H_2Cl_4$ and CS_2. Results indicate that the classical approach is reasonable. J.Hawg

9395 THE TEMPERATURE DEPENDENCE OF THE RAMA LINES IN GASEOUS AND LIQUID PHASES.

A.I.Sokolovskaya.
Optika i Spektrosk. (USSR), Vol. 9, No. 5, 582-6 (Nov., 1960).
In Russian.

Studies of the temperature dependence of the Raman line intensities of carbon tetrachloride, chloroform, benzene, acetone and acetonitrile in gaseous and liquid forms. Comparison of the results obtained with theoretical predictions show that the statisti theory of the temperature dependence describes the behaviour of gases well, where intermolecular interactions are small. In liquids theoretical temperature dependence of the Raman intensity, deduced an isolated molecule, is masked by strong intermolecular interactio [English translation in: Optics and Spectrosc. (USA), Vol. 9, No. 307-9 (Nov., 1960)]. A.Tybulew

9396 ELECTRIC FLUORESCENCE POLARIZATION: THE DETERMINATION OF DIPOLE MOMENTS OF EXCIT MOLECULES FROM THE DEGREE OF POLARIZATION OF FLUORESCENCE IN STRONG ELECTRIC FIELDS.

J.Czekalla.
Z. Elektrochem. (Germany), Vol. 64, No. 10, 1221-8 (1960).
In German.

The theory of the process gives an expression for the dipol moment of the excited state of the molecule in terms of measura quantities, provided that the ratio of the mean lifetime of the excited state of the dielectric relaxation time is > 3. The ratio be determined from the degree of polarization of fluorescence in the solution used, and in a solution of infinite viscosity. The exp mental arrangements include a Teflon cell, silver electrodes, ultraviolet excitation and applied fields up to 150 kV/cm, using solutions in benzol, dioxane, etc., of CN and NO_2 derivatives of stilbene and diphenyl. The degree of polarization evoked by the field is proportional to the square of the field strength, being 1% most. Dipole moments are tabulated and claimed accurate to 5% S.T.Hende

9397 THE DEPOLARIZATION OF THE FLUORESCENCE SOLUTIONS BY RADIATIVE AND RADIATIONLESS EXCITATION-ENERGY TRANSFER.

P.I.Kudryashov and B.Ya.Sveshnikov.
Dokl. Akad. Nauk SSSR, Vol. 134, No. 4, 792-4 (Oct. 1, 1960). In Russian.

The extent of the luminescence polarization of mixed solutions of trypaflavine and rhodamine in glycerine was investigated. The luminescence was stimulated with the 436 mμ merc line. The concentrations of the solutions used were 2.5, 5 and 10×10^{-5} mole/litre. A depolarization of the luminescence of rhodamine was observed, and it was found to depend on the long-wavelength fluorescence. The extent of the polarization of the secondary emission was found to vary from 4.5 to 7.0% with a m value of 5.6%. The theoretical value is 9.5%. [English translati in: Soviet Physics—Doklady (USA)]. K.N.R.Ta

9398 ON THE FLUORESCENCE OF FLUORESCEIN IN METHYL METHACRYLATE.

A.Baczynski, M.Czajkowski and S.Trawinski.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys. (Poland), V
No. 1, 47-51 (1961).

Measurements were made of the absorption and emission spectra of fluorescein in methyl methacrylate, the influence of ethanol on the positions of the band maxima, and the fluorescen polarization at different concentrations. J.B.

9399 YIELD OF ANTI-STOKES FLUORESCENCE OF CHLOROPHYLL. D.Frąckowiak and T.Marszałek.
ll. Acad. Polon. Sci. Ser. Sci. math. astron. phys. (Poland),
l. 9, No. 1, 53-5 (1961).

The fluorescence yield of chlorophyll-a in solution in ether was
easured as a function of wavelength from 6000 A to 7000 A.
J.B.Birks

9400 FLUORESCENCE YIELDS OF ACETYLANTHRACENES IN SOME SOLVENT MIXTURES. A.S.Cherkasov.
tika i Spektrosk. (USSR), Vol. 9, No. 4, 540-2 (Oct., 1960).
Russian.

The relative quantum yields of fluorescence of 1-acetylanthra-
ne and 2-acetylanthracene dissolved in hexane were raised by
addition of a second solvent, such as dioxane, acetone, pyridine,
thanol, n-octanol, benzyl alcohol and ethanol. On addition of
xane, pyridine and acetone, the yield rose almost linearly with
amount of the second solvent. Addition of alcohols or acetic
d raised the yields very rapidly at low second-solvent concentra-
ns with subsequent levelling off or even fall of the yield at higher
ncentrations of the second solvent. The special effect of alcohols
s due to formation of hydrogen bonds. Addition of a third solvent
le to form hydrogen bonds with alcohols neutralized the effects
the alcohols. [English translation in: Optics and Spectrosc.
SA), Vol. 9, No. 4, 285-6 (Oct., 1960)]. A.Tybulewicz

9401 ENERGY TRANSFER IN ORGANIC SYSTEMS. II. SOLUTE—SOLUTE TRANSFER IN LIQUID SOLUTIONS.
B.Birks and K.N.Kuchela.
oc. Phys. Soc. (GB), Vol. 77, Pt 5, 1083-94 (May, 1961).

For Pt I see Abstr. 4888 of 1958. Solute—solute intermolecular
ergy transfer was studied in the ternary solution system
uene-TP (p-terphenyl)-TPB (1, 1', 4, 4'-tetraphenylbutadiene)
th a TP concentration of 2.17×10^{-2}M, and TPB concentrations
m 1.5×10^{-6}M to 6×10^{-3}M, using excitation wavelengths from
5 to 365 mμ. The behaviour is described quantitatively by competi-
n between radiative transfer, which predominates up to 10^{-4}M, and
n-radiative dipole—dipole transfer, which becomes important at
her concentrations. The observed radiative transfer agrees with
t predicted from the TPB absorption and TP emission spectra,
d depends on the solution thickness. The observed dipole—dipole
nsfer corresponds to a critical transfer distance R_0 = 42.2 A,
mpared with a theoretical value of R_0 = 42.5 A, indicating that
lecular diffusion and TP excitation migration have a negligible
luence on the transfer process, which is single-step. The bearing
the results on the choice and design of organic scintillator
stems is briefly discussed.

9402 ENERGY TRANSFER IN ORGANIC SYSTEMS. III. SPECTRAL EFFECTS IN LIQUID SOLUTIONS.
B.Birks, K.N.Kuchela and F.H.Read.
oc. Phys. Soc. (GB), Vol. 77, Pt 5, 1095-6 (May, 1961).

The apparent dependence of the solvent—solute energy transfer
ficiency f on wavelength λ in toluene—terphenyl solutions previous-
reported (Pt I.) is shown to be due to the presence of toluene
pour which attenuates the incident light. With a sealed cell f is
dependent of λ from 220-270 mμ. Under these conditions f was
easured as a function of concentration, and the molecular para-
eters were evaluated. J.B.Birks

MEASUREMENT OF LUMINESCENCE INDUCED BY Po^{210}
LPHA-RAYS IN WATER. See Abstr. 9420

9403 ON A FIELD DEPENDENT DISPLACEMENT OF THE EQUIPOTENTIALS IN POLAR LIQUID DIELECTRICS
INHOMOGENEOUS ELECTRIC FIELDS.
H.Krawinkel and H.J.Zetzmann.
angew. Phys. (Germany), Vol. 13, No. 2, 76-80 (Feb., 1961).
German.

A fixed potential probe within the annulus of a concentric
linder electrode system was used to compare the measured
ential at this point with the theoretical value. With all the polar
uids tested, using d.c. voltages up to 8 kV, a considerable
crepancy was observed in the sense that the potential difference
ween probe and outer electrode was increased above the
oretical value. The effect increased with field. Non-linearity
the conduction current and a variation of permittivity with field
re also observed. It is indicated that the effects are due to
ce charges near the electrodes. K.W.Plessner

9404 DIELECTRIC RELAXATION IN LIQUIDS. I. THE REPRESENTATION OF RELAXATION BEHAVIOR.
D.W.Davidson.
Canad. J. Chem., Vol. 39, No. 3, 571-94 (March, 1961).

Methods are described for the determination from experimental data of the parameters used in the skewed-arc representation in the complex dielectric constant plane of dielectric relaxation in liquids. Graphs give the frequency dependence of the real and imaginary parts of the dielectric constant predicted by the skewed-arc equation. Evidence, which includes an analysis of published data and of some new data, is presented for the frequent occurrence of this type of relaxation behaviour in liquids. The resolution of the effects of different relaxation processes is discussed. The defect-diffusion model of Glarum is found to lead, under some conditions, to complex dielectric constant loci which are practically indistinguishable from skewed-arc loci over much of the frequency range of dispersion. It predicts departures from skewed-arc behaviour at relatively high frequencies which are possibly related to experimentally observed departures. It is concluded that skewed-arc characteristics arise from the presence of co-operative relaxation processes, possibly aided by the diffusion of disordered regions, in which the individual mechanisms of relaxation cannot be resolved by application of the superposition principle.

9405 DIELECTRIC RELAXATION IN PHENYL ALCOHOLS AT LOW TEMPERATURES. R.G.Bennett.
Arch. Sci. (Switzerland), Vol. 31, No. Fasc. Spec., 62-4 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961) The complex dielectric constant of three phenyl alcohols has been measured at frequencies between 1 kc/s and 3 Mc/s over a temperature range of -60^0 to -20^0C in order to compare the relaxation behaviour with that of monohydric aliphatic alcohols. To ascertain the effect of the proximity of the phenyl and hydroxyl groups the substances chosen were 2-phenyl propanol, 2 phenyl-ethanol and 1-phenyl propanol. The shape of the Cole—Cole diagrams and the activation energy is discussed.

9406 ELECTRICAL CONDUCTANCE OF SOLUTIONS OF SALTS IN LIQUID METALS. POTASSIUM IODIDE IN POTASSIUM. H.R.Bronstein, A.S.Dworkin and M.A.Bredig.
J. chem. Phys. (USA), Vol. 34, No. 5, 1843-4 (May, 1961).

A large decrease in the specific conductivity is observed on dissolution of KI in liquid K at 700^0C. G.I.W.Llewelyn

9407 A THERMAL MOTION EFFECT IN THE ELECTRON SPIN RESONANCE OF A FREE RADICAL IN SOLUTION. J.G.Powles and M.H.Mosley.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 729-36 (March, 1961).

The electron resonance hyperfine triplet at 9.5 mm wavelength of the peroxylamine disulphonate ion was measured in a series of solutions of water and glycerol from 20% to 72% glycerol by weight and over a temperature range from -46^0 to 65^0C. There is a temperature and solution dependent broadening which affects the individuals of the triplet differently. The high field line is broadened first with falling temperature. The effect is thought to be due to the motionally attenuated anisotropic electron—nuclear interaction. The anisotropic interaction is estimated to be comparable with the isotropic one. The anisotropy of the g factor, $\Delta g/g$, is 2×10^{-3}. These parameters allow the prediction of a static spectrum of the ion in agreement with experiment (Weissmann and Banfill 1953). The effect of thermal motion of the ion is shown by the close relation between the value and temperature dependence of the thermal reorientation correlation frequency and the variation of the electron resonance signal with temperature and nature of the solvent.

9408 MOLECULAR MOTION IN LIQUID TOLUENE BY PROTON MAGNETIC RESONANCE RELAXATION.
J.G.Powles and D.J.Neale.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 737-47 (March, 1961).

Measurements are reported of the proton spin—lattice relaxation time T_1 at 47.5 Mc/s for both the methyl and ring protons in liquid toluene over a wide temperature range by recovery from saturation of the high resolution signal. The two sets of protons relax independently and show a very different dependence on temperature. The ring proton T_1 has a minimum of 1.4 sec at -108^0C while the methyl proton T_1 is still falling at the lowest temperature -131^0C to which the liquid could be supercooled. The results are interpreted in terms of a complex thermal motion of the toluene molecules about more than one axis together with internal motions of the methyl group relative to the molecule. Plausible generalizations of current theories of magnetic resonance relaxation are made to facilitate the analysis. It is suggested that very considerably increased information about molecular liquids is obtainable from magnetic measurements by such a study of each chemical type of proton within a molecule, when present.

9409
TEMPERATURE DEPENDENCE OF PROTON SPIN–LATTICE RELAXATION TIMES IN SOME PURE LIQUIDS.

J.Blicharski, J.W.Hennel, K.Krynicki, J.Mikulski, T.Waluga and G.Zapalski.
Arch. Sci.(Switzerland), Vol. 13, No. Fasc. Spec., 452-63 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). Proton spin–lattice relaxation times T_1 for oxygen-free liquid $CHCl_3$, $CHBr_3$, H_2SO_4, CH_2Cl_2, CH_3Cl and NH_3 were measured at different temperatures at a resonant frequency of 28 Mc/s. The results obtained at 20°C were compared with the values calculated by means of the formulae derived for the case of interaction of two different sorts of nuclei in a pure liquid. The experimental values were usually less than the theoretical ones. A decrease of the expression $T_1\eta/T$ with increasing temperature was found for several pure liquids containing one, two and three protons per molecule. Theory predicts that this expression should be independent of temperature. The disagreement with theory is considered to be due to the failure of simplified model of molecular motion.

9410
NUCLEAR SPIN RELAXATION IN GASES AND LIQUIDS. I. CORRELATION FUNCTIONS.

I.Oppenheim and M.Bloom.
Canad. J. Phys., Vol. 39, No. 6, 845-69 (June, 1961).

Calculation of nuclear spin-lattice relaxation time T_1 in liquids and gases involves the correlation functions of the matrix elements between different spin states of the interaction coupling the nuclear spin to other degrees of freedom of the system. The correlation functions are expressed in terms of a time-dependent pair-distribution function (TDPDF) for the system. The TDPDF is evaluated using the Wigner distribution function to describe the equilibrium ensemble of the gas or liquid. A time expansion of the dynamics of the system to a constant acceleration approximation and use of the symmetry properties of the TDPDF leads to an expression of the form

$$g(R^2, R'^2, t) = [g(R)]^{1/2} [g(R')]^{1/2} P(R^2, R'^2, t).$$

This form for the TDPDF is derived for the high temperature dilute gas, for the dilute gas with first quantum correction, and for classical liquids in which the molecular dynamics can be described by the Langevin equation. The quantity $g(R)$ is the radial distribution function appropriate to each case. The quantity $P(R^2, R'^2, t)$ is the free particle TDPDF for the classical gas; it is the classical free particle TDPDF at an effective temperature for the quantum gas; it is the product of solutions to the diffusion equation for the liquid multiplied by the $(\text{density})^2$.

9411
INFLUENCE OF THE HYDROGEN BOND ENERGY ON THE NUCLEAR RESONANCE SPECTRA OF PHENOLS.

I.Gränacher.
Helv. phys. Acta (Switzerland), Vol. 34, No. 4, 272-302 (1961).
In German.

High resolution nuclear magnetic resonance spectra of the OH-hydrogen and the ring-hydrogen nuclei of phenols were observed in a large number of solvents. The chemical shifts of the hydrogen-bonded hydroxyl-proton of phenol are correlated with the corresponding shifts of the infrared absorption band. It is shown that there exists a linear correlation, which can be used to derive the H-bond energies from the potential function of Lippincott and Schröder. The observed shifts of the H-bonded hydroxyl-proton in the electrostatic and magnetic field of the acceptor molecule were calculated using the model of H-bonding proposed by Paoloni. The spectra of the ring-hydrogen nuclei of para- and ortho-substituted phenols were also investigated. H-bonding produces remarkable shifts in the spectra of the aromatic ring of phenols. The spreading of a perturbation of the OH-group throughout the whole molecule, which participates in the H-bond, is discussed.

MECHANICS OF GASES

ELECTROSTATIC PHENOMENON RESULTING FROM THE PRESENCE OF SOLID PARTICLES IN AERODYNAMIC FLOWS. See Abstr. 9522

ON SIMILAR SOLUTIONS OF THE STEADY QUASI-TWO-DIMENSIONAL INCOMPRESSIBLE LAMINAR BOUNDARY-LAY EQUATIONS. See Abstr. 9372

9412
WAVE PHENOMENA IN COMPRESSED-AIR DUCTS.

H.Forwald.
Asea Res. (Sweden), No. 5, 5-149 (1960).

After treating the basic equations for the theory of elastic waves, the wave phenomena occurring in conjunction with the ra filling and discharge of ducts with compressed air are describe Wave experiments, mainly intended to provide information for th designing of air-blast circuit-breakers, are described and the re are graphically reproduced. The treatise is supplemented by a historical and bibliographical survey of the research work into in compressible media.

Shock Waves

9413
SIMILARITY OF INVISCID HYPERSONIC FLOWS N THE STAGNATION POINT OF A BLUNT OBSTACL

A.Auriol and J.Balazard.
C.R. Acad. Sci. (France), Vol. 252, No. 11, 1559-61 (March 13,
In French.

Generalizes earlier work for particular shapes such as spheres or cylinders. The conclusion is that two flows are "si if the values of $\rho(H - H_0)/p$ are equal at corresponding points in the flows, where p is the pressure, ρ the density, H the enthalpy an H_0 the enthalpy upstream of the shock. Calculations show prom agreement in specific cases. N.

SHOCK WAVE COMPRESSION OF Fe AND Bi USING PROJ TILES FROM A HELIUM GUN. See Abstr. 9090

9414
DETONATION IN A TUBE WITH AN OPEN SPACE BETWEEN CHARGE AND TUBE WALL.

H.L.Sel
Ark. Fys. (Sweden), Vol. 18, Paper 17, 283-8 (1960).

A theoretical treatment is given of the detonation of a cyl rical solid charge in a non-deformable cylinder of larger diam The condition in which a shock wave in the gas between charge wall may precede the solid detonation is studied. A.G.G

9415
NORMAL AND SUPERNORMAL DETONATION VELOCITY.

H.L.Selberg.
Ark. Fys. (Sweden), Vol. 18, Paper 22, 353-6 (1960).

A theoretical treatment is given for the condition that a cylindrical solid charge may detonate at a speed exceeding the Chapman-Jouguet value. A.G.G

GASEOUS STATE

9416
MASS SEPARATION BY DIFFUSION OF REACTIN GASES.

W.Frie and H.Maecker.
Z. Phys. (Germany), Vol. 162, No. 1, 69-83 (1961). In German

The composition of reacting gases at constant pressure as function of temperature is usually calculated by means of the mass action law in connection with Dalton's law and the compo in the initial state. In open systems with temperature gradien this is in general no longer correct because owing to diffusion currents, in particular those of reacting species, the composit becomes space-dependent. Starting from considerations of the thermodynamics of irreversible processes, a method for calcu such systems is presented and applied to some special cases. In these particular attention is given to the degree of de-mixin By this theory separation processes observed in electric arcs can be interpreted. H.L

9417
CORRESPONDING STATES OF GASES.

J.Duclaux.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1703-4 (March 20,
In French.

The compressibility coefficients given by the equation $\log K_n = A + B[n(n + 1)]^{-1/2}$ and shown previously to be valid en (Abstr. 14681 of 1960) where BT = 101.3, are now reported rue for argon and possibly for oxygen. It is claimed that with ate compressibility data, only one isotherm is required for duction of B and thence the critical temperature by compari- th another gas according to the correspondence law.

H.H.Hodgson

8 IDEAL GAS THERMODYNAMIC FUNCTIONS AND ISOTOPIC EXCHANGE FUNCTIONS FOR THE
MIC HYDRIDES, DEUTERIDES, AND TRITIDES.

r, A.S.Friedman and C.W.Beckett.
ur. Stand. (USA), Monogr. No. 20, 271 pp. (1961).

ontains a consistent set of tables of thermodynamic rties for the ideal gas state at one atmosphere pressure. ncludes properties for chemical reactions involving the ic exchange of hydrogen. The properties tabulated are: heat ty, enthalpy, Gibbs free energy, and entropy.

HE THERMAL CONDUCTIVITIES OF NORMAL- AND PARA- OGEN AT 20°K. See Abstr. 9382

19 ROTATIONAL RELAXATION IN HYDROGEN CHLORIDE. M.A.Breazeale and H.O.Kneser.

oust. Soc. Amer., Vol. 32, No. 7, 885-6 (July, 1960).

he absorption and velocity of sound in hydrogen chloride was ured by use of the pulse technique. Between f/p = 0.5 and 16 Mc/s atm^{-1}, the measured absorption is 1.47 times the cal absorption. The number of collisions during one relax- time is Z_{rot} = 7. The low value of Z_{rot} is attributed to the at HCl has a strong dipole moment.

HE TEMPERATURE DEPENDENCE OF THE RAMAN LINES IN OUS AND LIQUID PHASES. See Abstr. 9395

20 MEASUREMENT OF LUMINESCENCE INDUCED BY Po^{210} ALPHA-RAYS IN AIR AND IN WATER.

uesne and I.Kaplan.
s. Radium (France), Vol. 21, No. 10, 708-16 (Oct., 1960).
nch.

description of the experimental device is given, the main of it being a 51 UVP photomultiplier with a quartz window. hod is suggested of determining the number of photons ced individually by each α particle in the scintillating sub- . The shape of the pulse spectrum connected with the ion of light is explained. The geometrical efficiency of light tion is calculated by means of different hypotheses as to the bution of the photons along the track of the α-particles. The ivity of this mode of detection shown by the fact that vation is possible of such a small scintillation as that of water, has been estimated as 2–3 photons per α-particle of 2.5 MeV, range of wavelengths from 2200 to 5200 A. In air, the hemical yield has been evaluated as 6 × 10^{-4} photon per ion in the same range of wavelengths, and a rough experiment evidence that nitrogen is responsible for the luminescence.

21 THE DISTRIBUTION OF LUMINESCENT PHOTONS EMITTED ALONG AN α-TRAJECTORY IN A GAS.

uesne and I.Kaplan.
cad. Sci. (France), Vol. 252, No. 1, 102-3 (Jan. 4, 1961).
nch.

e distribution of photons emitted from the path of a parallel of α-particles in nitrogen at pressures less than 65 cm Hg wn to be similar to the Bragg curve for the distribution of The total number of photons however, increases with sing pressure.

J.Dutton

2 CALCULATION OF THE ELECTRICAL CONDUCTIVITY AND TEMPERATURE OF A FEEBLY IONIZED GAS.

e.
Acad. Sci. (France), Vol. 251, No. 22, 2464-6 (Nov. 28, 1960).
nch.

n extension of earlier work which demonstrates certain rties of a linear collision operator based on a r^{-5} law is used mate the temperature and electrical conductivity tensor of nd electrons.

C.G.Morgan

3 THE COMPLEX DIELECTRIC CONSTANT AT LOW MICROWAVE FREQUENCIES OF ETHYL CHLORIDE
BED ON POROUS VYCOR GLASS.

cCowan and R.McIntosh.
. J. Chem., Vol. 39, No. 3, 425-42 (March, 1961).

he complex dielectric constant of the system Vycor glass—ethyl chloride has been measured at three temperatures in the range +11°C to −33°C and in the frequency range between 500 Mc sec^{-1} and 4000 Mc/s by the use of a coaxial line. The real and imaginary parts of the dielectric constant of the adsorbate were also evaluated. Appreciable loss in the adsorbed matter is found for small quantities adsorbed, and loss is again detected at the highest frequencies and lowest temperatures for the matter held in multilayers or condensed in capillaries. The frequency range and accuracy of measurement were not sufficient to classify the type of loss curve, but other evidence suggests that the loss for the first quantities adsorbed will turn out to be that for rotational oscillators. In general earlier observations of this system are confirmed and extended.

9424 ON THE NUCLEAR SPIN RELAXATION IN HYDROGEN GAS. G.T.Needler and W.Opechowski.

Canad. J. Phys., Vol. 39, No. 6, 870-80 (June, 1961).

The Schwinger formula for the relaxation time T_1 of nuclear spins in hydrogen gas is valid only for sufficiently low temperatures. In this paper an approximate theory of T_1 is developed valid for any temperature. An explicit expression is given for T_1 valid for temperatures up to room temperature; this expression reduces to the Schwinger formula for sufficiently low temperatures.

NUCLEAR SPIN RELAXATION IN GASES AND LIQUIDS. See Abstr. 9410

VACUUM PHYSICS

9425 STANDARD UNIT OF PRESSURE IN VACUUM PHYSICS.

N.A.Florescu; P.H.Bigg.
Nature (GB), Vol. 190, 522-3 (May 6, 1961).

Florescu suggests his previous contribution (Abstr. 19222 of 1960) has been misunderstood (Abstr. 5298 of 1961). The purpose was to obtain an acceptable compromise between absolute pressure units and the height of the mercury column in a liquid manometer under specified conditions. In reply Bigg contends that there is no justification for introducing the new unit "vac" involving a new arbitrary reference gravity when the scale it would provide in vacuum practice be indistinguishable from a scale in millibars.

W.Steckelmacher

9426 HIGH-VACUUM PUMPS AND UNITS FOR ACCELERATORS.

S.A.Vekshinsky, M.I.Menshikov and I.S.Rabinovich.
Vacuum (GB), Vol. 9, 201-6 (July-Sept., 1959; publ. Dec., 1959).

Details are provided of a three-stage 380 mm diameter oil-diffusion pump of speed 5000 l./sec. A water-cooled cap and a liquid-nitrogen-cooled echelon are described; these baffles are suitable for use with pumps of the above type, when back-streaming of the pump fluid vapour is to be minimized without serious reduction of pumping speed at pressures in excess of 1 × 10^{-6} torr.

F.A.Baker

9427 IMPROVED WREDE GAUGE.

R.A.Sharpless, K.C.Clark and R.A.Young.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 532-7 (May, 1961).

An improved Wrede gauge having the following characteristics is described: (a) a response time of ~1 sec, (b) sensitivity sufficient to detect ~10^{-5} mm Hg partial pressure of atoms. This was accomplished by (a) reducing the trapped volume bounded by the catalytic surface and the effusion diaphragm, and using 130 effusion holes of 0.020 mm diam. in plastic films of 6.4 × 10^{-3} mm thickness and by (b) balancing the atom-induced pressure difference across the effusion holed as sensed by a capacitative pressure transducer with an electrostatic pressure and recording the square of the voltage between the capacitor elements. Possible sources of error when the device is used to measure the decay of atoms in pulsed afterglows of long duration are discussed.

9428 A SENSITIVE VACUUM LEAK DETECTOR USING A RADIO-FREQUENCY MASS SPECTROMETER.

F.Kanematsu.
Mem. Fac. Engng Osaka City Univ. (Japan), Vol. 1, 57-62 (Dec., 1959).

Single and double-stage Bennett type radio-frequency mass spectrometer tubes were tested as a vacuum leak detector. When hydrogen was used as probe gas, the minimum detectable change in partial pressure was 1 × 10^{-8} mm Hg or less. It was found that for these tubes, no special advantages were observed by the use of helium in comparison with hydrogen, because of their relatively high background ion current. For the effective use of helium, it may be necessary to take a three-stage mass spectrometer tube, which may be effective as a vacuum analyser as well.

9429 EXPERIENCE IN DESIGNING AND MANUFACTURING ALL-METAL VACUUM SYSTEMS.

M.L.Lyubimov, K.P.Shakhov and Ya.A.Yukhvidin.
Vacuum (GB), Vol. 9, No. 2, 108-16 (May 1959; publ. Dec., 1960).

A comprehensive and well illustrated account is given of the all-metal demountable joints, valves and cold traps developed by the authors over the past ten years. It is claimed that the high reliability and operational convenience of such devices has ousted the glass vacuum system from laboratories and industry. Some consideration is given to the optimum diameters of the various types of joints and valves discussed. No justification is found for using gold or silver gaskets in preference to aluminium or oxygen-free copper. Gold-plated copper is recommended, however, as a gasket for diffusion seals. The problem of degassing metal components is not considered. F.A.Baker

9430 EXPERIENCE IN USING MASS-SPECTROMETRIC METHODS IN ELECTRO-VACUUM TECHNOLOGY.

I.A.Kaljabina and Ya.A.Yukhvidin.
Vacuum (GB), Vol. 9, 117-25 (May, 1959; publ. Dec., 1960).

Details are given of the technological points considered in applying mass spectrometry to some problems of gas desorption. For gas desorption studies with particular materials, specimens were heated within the ionization chamber of a full-size 60° magnetic deflection mass spectrometer. The advantages of portable mass-spectrometric vacuum analysers are discussed, particularly for controlling evacuation conditions; a number of examples of the sort of problem that has been solved using such techniques are given. In particular, these examples relate to the evolution of gases (e.g., O_2 and CO) that poison cathodes in electronic valves. F.A.Baker

9431 A SIMPLE FLEXIBLE VACUUM JOINT.

P.I.P.Kalmus.
Vacuum (GB), Vol. 9, 147 (May, 1959; publ. Dec., 1960).

This joint relies on a rubber "O"-ring which is retained by a suitable metal flange. Three screws in a collar, attached to the tube that is inserted, provide means of both tilting and adjusting the effective length of the tube. With continuous pumping a working pressure ~ 10^{-4} torr is possible. F.A.Baker

9432 A SHUTTER FOR USE BETWEEN SOURCE AND WORK DURING VACUUM EVAPORATIONS.

W.R.Lamb, F.A.Rhoads and P.S.Applebaum.
Vacuum (GB), Vol. 9, 147-8 (May, 1959: pub. Dec., 1960).

The electromagnetically operated aluminium foil shutter described prevents dirt, present on the source, from reaching the work during degassing. It is claimed that this arrangement takes up less space than coventional apparatus and requires no cleaning between evaporation runs. F.A.Baker

9433 ELECTRICAL CLEAN-UP OF GASES IN HOT CATHODE DISCHARGE TUBES. G.Carter.

Vacuum (GB), Vol. 9, 190-200 (July-Sept., 1959; publ. Dec., 1959).

Review, particularly of the clean-up of inert gases. Following a reference to some of the author's own work, in which it was shown that the maximum rate of desorption of previously pumped argon from the glass walls of a Bayard—Alpert gauge occurred at 525°C, the different conclusions about the mechanism of clean-up arrived at by various workers are indicated in a table. It is concluded that either (a) positive ions may impinge on the glass lattice with sufficient energy to penetrate between the lattice atoms, or (b) cleaned-up particles may enter narrow superficial cracks or surface dislocations. The latter possibility sets an upper limit to the total number of particles that may be accommodated, as is observed in practice. The depth of ion penetration is thought to depend on incident energy; all atoms, other than helium which diffuses through glass, are expected to be trapped as impurities within the glass. F.A.Baker

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VIBRATIONS . ELASTIC WAVES

(See also Shock Waves)

9434 INSTRUMENT FOR MEASURING AMPLITUDES O SMALL VIBRATIONS. K.V.Chernyshev.

Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 99-103 (Nov.-Dec
In Russian.

Details of the construction and calibration of an instrume
are described for measuring, by capacitative means, the ampl
of vibration at a given point. A miniature probe attached to a
bimorph crystal picks up the vibrations and after amplificatio
and filtering these are depicted on the screen of an oscillogra
which serves as a sensitive null indicator. An accuracy of
0.5 - 1 × 10^{-8} cm is claimed. [English translation in: Instrum
exper. Tech (USA), No. 6, 956-61 Nov.-Dec., 1959; publ. Sept.,
1960)]. H.J.H.S

9435 ON THE INDICATION OF VIBRATION NODES BY POWDERS. A.F.B.Wood.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 1076-82 (May, 1961).

A simple theory is used to explain the motion of small par
on a horizontal surface vibrating with any combination of horiz
and vertical displacements. The motion depends on the relativ
phase of these displacements and causes the powder to collect
some of the nodes of the vertical and some of those of the hori
displacement, but, except in particularly simple modes, not at
the nodes of either. The use of a powder to indicate vibration
can therefore be misleading unless backed up by an other meth
such as interferometry, which can discriminate between displa
ments parallel and normal to the vibrating surface.

9436 APPLICATION OF THE ELECTRICAL ANALOGY THE DETERMINATION OF PRESSURE ALONG P IN FORCED CHARACTERISTIC VIBRATION. J.Piquemal.

C.R. Acad. Sci. (France), Vol. 252, No. 12, 1728-30 (March 20
In French.

A comparison of results obtained by an electrical analog
those obtained by a graphical method. T

9437 CALCULATIONS OF RANDOM FATIGUE OF HAR SPRING RESONATORS. P.W.Smith, Jr.

J. Acoust. Soc. Amer., Vol. 33, No. 6, 752-6 (June, 1961).

Computations have been made for the effect of a nonlinea
of the hard-spring type upon the fatigue damage ensuing on e
tation of a resonator by a stationary, broad-band, random Ga
force. The fatigue theory used assumes a simple accumulati
damage in proportion to a power of the peak values of respon
strain, without interactions between peaks. Two cases are di
guished: (a) strain proportional to displacement; (b) strain n
linearly dependent on displacement, as is the surface fibre s
in a bar with pinned ends, responding in a single mode. Num
results are presented that indicate for case (a) a continuous c
crease, with increasing nonlinearity, of the rate of accumulat
damage, while for case (b) this damage rate increases to a m
mum as large as 3.4 times the linear estimate, and then falls
low the value for linear response. Probability density (in res
amplitude) of damage is greater at small amplitudes, and les
large, than for the linear case. The value of response amplit
maximum damage density is also affected by nonlinearity.

9438 DENSITY OF PEAKS IN RANDOM RESPONSE OF HARD-SPRING RESONATORS. P.W.Smith, Jr.

J. Acoust. Soc. Amer., Vol. 33, No. 6, 814-15 (June, 1961).

The shape of curves for peak density of response of hard
spring resonators depends significantly on the choice of varia
and the choice of normalization constant (the r.m.s. value of
variable). The curves for the variables: (1) displacement (b
strain in pinned bar) normalized to linear expectation of r.m.
(2) displacement normalized to actual r.m.s. and (3) total str
(bending plus membrane, in pinned bar) normalized to linear
pectation of r.m.s. — are compared with the linear case. C
are made on the problems of comparing experimental data wi
these curves.

9439 EFFECT OF MEMBRANE STRAIN ON FATIGUE DAMAGE RATE. ASYMPTOTIC CALCULATION

R.H.Lyon.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 815 (June, 1961).

The effect for a bar with simply supported ends is calcul on asymptotic expressions for the extremal moments of a pring oscillator. The calculations are appropriate for a high of nonlinearity. Comparisons with numerical calculations isfactory.

ACOUSTICS

40 REMARKS ON THE WORK "M.HECKL, SOUND RADIATION FROM PLATES WITH POINT EXCITATION" IN ICA 9 (1959) 376. E.J.Skudrzyk.
ca (Internat.), Vol. 10, No. 2, 129 (1960). In German.
e author points out that two of his papers (Abstr. 2155, 3239) have been incorrectly criticized by Heckl (Abstr. 203). Reference is made to a paper by M.Gösele (Abstr. 2140) in support of the author's views. A.B.Wood

REPLY TO THE REMARKS BY E.J.SKUDRZYK.
M.Heckl.
ca (Internat.), Vol. 10, No. 2, 129-30 (1960). In German.
brief note in reply to the previous abstract. A.B.Wood

2 SMOOTHLY AND STEP TAPERED STRUCTURES.
F.J.Young and B.H.Young.
ust. Soc. Amer., Vol. 33, No. 6, 813 (June, 1961).
is shown that a manifold of uniform tubes becomes a smoothly d horn as the number of members in the manifold increases ity. (See also Abstr. 5325 of 1961).

3 ON THE SIMULTANEOUS EXCITATION OF TWO FREQUENCIES PRODUCED BY A SYSTEM OF LED ACOUSTIC TUBES. G.Bousseau.
cad. Sci. (France), Vol. 251, No. 20, 2138-40 (Nov. 14, 1960). nch.
n acoustic oscillating system is described, consisting of an nded tube excited at one end by a loudspeaker, with a probe phone at the centre of the tube connected to the loudspeaker amplifier, which maintains the system in oscillation. The roximity of another tube causes a shift in the frequency of tion of the first system, two distinct frequencies being ined indefinitely by the system as a whole if the correct ng is achieved. Beats are clearly audible. M.L.Gayford

4 UTILIZATION OF MAGNETOSTRICTIVE MATERIALS IN GENERATING INTENSE SOUND. R.R.Whymark.
ust. Soc. Amer., Vol. 33, No. 6, 725-32 (June, 1961).
e intense sound output at resonance in a laminated nickel calculated from static measurements of the relationship of e magnetostrictive strain to the intrinsic induction. The ions of the linear theory are avoided by determining the c magnetostrictive stress which is taken to be the motivating ce of the mechanical vibrations. The dynamic magnetostric-ress is obtained by graphical methods that are not limited to excitation amplitudes, as is the case in the linear theory. relationships of the dynamic magnetostrictive stress to the ances of the transducer-load system enable the sound output etermined from the calculated magnitudes of the magneto-ve stress. The calculated sound output is compared with the output measured on a laminated bar of annealed nickel, reson-ongitudinally at 20 kc/s, and coupled to an acoustic load con- of a half-wavelength stub of highly dissipative cast iron. und energy delivered to the load is measured by a flow calori- and mechanical transformers which are either solid expo- horns or stepped stubs are used to change the acoustic load imize the load power. The calculated sound outputs agree in ± 10% with the sound outputs measured calorimetrically. easured maximum of the sound intensity is 167 W/cm^2, while tions show that 492 W/cm^2 ultimately can be generated e annealed nickel. Estimated intensities for a more freely d specimen are in excess of 1 kW/cm^2.

5 OPTICAL MEASUREMENT OF ULTRASONIC FIELDS.
R.F.Weeks.
st. Soc. Amer., Vol. 33, No. 6, 741-7 (June, 1961).
apparatus is described which facilitates the measurement asonic fields within transparent solids. This optical system use of the birefringence produced within the solid by the e of an ultrasonic wave. The interaction of light with ultra-ields is discussed and expressions derived for the modulation t by both transverse and longitudinal ultrasonic waves. s detection systems are discussed and the reasons for the choice of a system making use of a wide slit in conjunction with a pulsed ultrasonic source, are given. An electronic apparatus, assembled for the most part from commercially available components to implement the measurement, is described. The output of the system is a strip chart recording of the strength of the ultrasonic field along a line. The advantages and limitations of the electronic system are discussed. A typical measurement made with the apparatus is shown and suggestions are given to extend the range of the apparatus.

9446 ON THE ACOUSTIC RADIATION FROM A FLANGED CIRCULAR PIPE.
Y.Nomura, I.Yamamura and S.Inawashiro.
J. Phys. Soc. Japan, Vol. 15, No. 3, 510-17 (March, 1960).
The problem of sound radiation from a circular pipe fitted with an infinite flange is solved. The radiation impedance, the transmission coefficient, the power gain function and the end correction are evaluated numerically and shown as functions of the wavelength.

9447 DISTORTION OF FINITE AMPLITUDE SOUND WAVE.
A.Powell.
J. Acoust. Soc. Amer., Vol. 32, No. 7, 886 (July, 1960).
A simple, approximate method yielding results of good accuracy is given for finding the time-dependent Fourier components of an initially sinusoidal sound wave of finite amplitude.

9448 PROPAGATION OF AUDIOFREQUENCY SIGNALS IN A PLANE LAYER OF WATER WITH A SURFACE DISTURBED BY WAVES. L.N.Zakharov.
Akust. Zh. (USSR), Vol. 6, No. 4, 454-61 (1960). In Russian.
Discusses the effect of surface waves on the amplitude and phase shift of audiofrequency acoustic signals propagated in a plane layer of water. A statistical analysis of experimental results gave quantitative relationships between fluctuations of the signal and heights of the surface waves. [English translation in: Soviet Physics — Acoustics (USA), Vol. 6, No. 4, 455-61 (April-June, 1961)]. A.Tybulewicz

9449 ULTRASONIC ATTENUATION IN WATER CONTAINING BRINE SHRIMP IN SUSPENSION.
J.Gruber and R.Meister.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 733-40 (June, 1961).
A study is made to determine the frequency and concentration dependence of the ultrasonic attenuation in aqueous suspensions of hatched and unhatched brine shrimp in the frequency range 1-45 Mc/s. In both types of suspensions a linear relationship is found to exist between the excess attenuation and concentration at each frequency. The attenuation caused by hatched brine shrimp is found to be the same when the organisms are either living or dead. For both types of suspensions the major cause of the excess attenuation is attributed to a scattering mechanism. Over the range of frequencies studied, while the excess attenuation in a hatched brine shrimp suspension varies as the 1.35 power of frequency, the attenuation caused by unhatched brine shrimp exhibits a maximum. The fact that the unhatched brine shrimp can be considered as small spherical particles allows calculation of the scattering loss, which, when subtracted from the measured values, results in a resonance type loss. The measured loss maximum associated with this resonance occurs at a frequency coincident with the principle mode of oscillation calculated assuming the eggs to be spherical cavity oscillators. A simple theory of geometric scattering from unhatched brine shrimp gives attenuation values which agree exactly with those measured above 20 Mc/s.

9450 ON THE REFLECTION OF SOUND FROM A GRATING.
U.Ingard.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 812-13 (June, 1961).
The reflection is discussed in the case when the slit width of the grating is small compared to half a wavelength of the incident sound. Then only the specular reflection will be present. The corresponding reflection coefficient is determined as a function of the angle of incidence of the sound and the results are applied to study the influence of a floor grating on the acoustic performance of an anechoic room.

TOTAL REFLECTION AND BACKWARD RADIATION FROM "SECONDARY SOURCES" ACCORDING TO HUYGENS' PRINCIPLE. See Abstr. 9466

9451 SOUND SCATTERING OF GAS BALLOONS. H.W.Helberg.
Acustica (Internat.), Vol. 9, No. 2, 118 (1959). In German.

Measurements were made in a reflection-free room at 5 m distance from a loud-speaker, of the sound transmitted to a microphone by a child's balloon, filled with various gases (air, CO_2 and hydrogen) at various pressures. Level recorder diagrams, covering frequency range 0.2 to 10 kc/s show two curves (1) without balloon, and (2) with balloon. With an air filled balloon the two curves are practically the same, only above 8 kc/s the level through the balloon falls about 5 dB. With the CO_2 filled balloon (a) normally and (b) "strongly" filled the sound pressure (above 700 c/s) increases from 5 to 10 dB. With the hydrogen filled balloon (small, normal and high filling) the sound pressure above 700 c/s decreases 10 to 20 dB. The stronger the balloons are blown, the greater is the effect. In the range 50 to 500 c/s, in all cases both curves are practically the same. A.B.Wood

9452 VIBRATIONS OF THE REED AND THE AIR COLUMN IN THE CLARINET. J.Backus.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 806-9 (June, 1961).

The vibrations of an artificially blown clarinet were studied by a photoelectric method in which light from a source placed at the bell of the instrument passed through the aperture between the reed and the mouthpiece and into a photomultiplier tube whose output was observed on an oscilloscope. It was found that for loud tones the aperture is practically completely closed for about one-half cycle and completely open for the other half. For softer tones the aperture does not close completely and the reed motion becomes nearly sinusoidal. A small condenser microphone inserted in the clarinet mouthpiece allowed simultaneous observations of the reed vibrations and air column vibrations to be made. It was found that during that part of its motion that the reed is not in contact with the mouthpiece, it follows, quite faithfully the variations in mouthpiece air pressure. The sound pressure level in the mouthpiece reaches 166 dB for loud tones; this value checks well with the pressure required for blowing the instrument. The increased loudness of the clarinet on harder blowing is due primarily to the increased production of harmonics.

9453 ON THE STATIONARY VIBRATIONS OF ORGAN PIPES. H.Dänzer.
Z. Phys. (Germany), Vol. 162, No. 5, 516-41 (1961). In German.

A theoretical paper, divided into four parts, dealing with flue organ pipes. Part I shows that the flue pipes of the organ can be regarded as back-coupled vibration generators analogous to electric oscillators. In parts III and IV, the electro-acoustic analogy is developed theoretically. In part II the theory of the electrical control is developed in which the phase relationship between grating and oscillatory circuits is derived. The phase relation between "anode a.c. current" and sound pressure in a resonating organ pipe are similarly considered. It is shown how the frequency is dependent on the blowing pressure. A.B.Wood

HEATING OF A PLASMA BY ACOUSTIC WAVES.
See Abstr. 9595

THE INFLUENCE OF THE MECHANICAL PROPERTIES OF A SOLID ON THE RATE OF ULTRASONIC MACHINING.
See Abstr. 9241

DIFFRACTION OF LIGHT BY VERY HIGH FREQUENCY ULTRASONIC WAVES. See Abstr. 9485

Instruments and Measurements

9454 OPTICAL CALIBRATION OF VIBRATION PICKUPS AT SMALL AMPLITUDES.
V.A.Schmidt, S.Edelman, E.R.Smith and E.Jones.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 748-51 (June, 1961).

A photometric device for accurately measuring the amplitudes of sinusoidal vibrations is described. The device is designed for calibrating vibration pickups. The apparatus employs a Fizeau-type interferometer with a photomultiplier observing the fringe pattern. The method is applied to the measurement of vibrations throughout the audio and near ultrasonic frequency range with amplitudes ranging from 72 to 4400 A. Extension to amplitudes as low as 5 A can be made with some modification to the apparatus,

9455 AN ULTRASONIC RECEIVER BASED ON A SEMICONDUCTING THERMISTOR. É.K.Labartkava.
Akust. Zh. (USSR), Vol. 6, No. 4, 468-71 (1960). In Russian.

Describes a bead-shaped semiconducting receiver of soun in the form of a small thermistor inside a spherical shell of Plexiglas (Perspex). [English translation in: Soviet Physics - Acoustics (USA), Vol. 6, No. 4, 468-71 (April-June, 1961)]. A.Tybu

9456 ACOUSTIC MEASUREMENTS UNDER TRANSIENT TEMPERATURE CONDITIONS. W.L.Paine.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 816 (June, 1961).

A quick and simple method of determining the effect of te ture change on the response of an underwater sound transducer described. The method requires precooling or warming the tr ducer to the extreme temperature of interest and then monitor its response while its temperature returns to ambient.

Noise . Architectural Acoustics

9457 AMBIENT NOISE IN A DEEP INLAND LAKE. M.R.Lomask and R.A.Saenger.
J. Acoust. Soc. Amer., Vol. 32, No. 7, 878-83 (July, 1960).

Background noise spectra from 11 to 250 c/s was obtained a deep inland lake in the absence of wind, waves, shipping, and marine life. An upper estimate of the spectrum level is given. is 10 dB lower than that of the Knudsen zero sea-state curve a extrapolation to 11 c/s. Measurements were also made of the variation in time for the spectrum under moderately rough surf conditions. From 90 to 250 c/s the spectrum appears to be generated by the wind, and there is no significant depth effect a these frequencies over the depth range 68-244 ft. This report discusses special instrumentation problems in the measureme very low-level, nonstationary ambient noise.

9458 ON THE ACOUSTIC PROPERTIES OF THE NEW BEETHOVENHALLE IN BONN.
E.Meyer and H.Kuttruff.
Acustica (Internat.), Vol. 9, No. 6, 465-8 (1959). In German.

The room has a volume of 16 000 m^3, with seating for abo 1420 and for a full-house an effective area of 1150 m^2. Diagra are given of the plan and longitudinal vertical cross-section of this room. A diagram indicates the results of measurements reverberation time of the room, occupied and unoccupied, ove frequency range 10^2 to 10^4 c/s. A.B

9459 REMARKS ON THE MEASUREMENT OF SOUND ABSORPTION IN AUDITORIA HAVING COMPLET DIFFUSIVITY. W.Kuhl and U.Kath.
Acustica (Internat.), Vol. 10, No. 2, 125-6 (1960). In German.

Discusses the implications of a paper by Meyer and Kuttr [Nachr. Akad. Wiss. Göttingen, math.-phys., Kl. (Germany), 1 No. 6, 98-114] on acoustic model research in the construction an auditorium. The paper points out the important influence c reverberation times (and absorption factors) due to the degre "diffusivity" of the walls and contents of the room. The absor strips (or sheets) of material as affected by edges, width and location is considered. Ten references to published papers d with this question are quoted. A.

9460 VOLUME PER SEAT AND VARIATION OF THE REVERBERATION TIME WITH THE SIZE OF TH AUDIENCE. J.R.Carbonell and J.L.Zuccoli.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 757-9 (June, 1961).

A maximum relative variation must be stated as a design dition for a hall together with the value of the reverberation itself (for instance, 1.3 sec at 500 c/s, ±10%). It is interesti and very useful to compute, quantitatively, how a change in th type of seats, the volume of the hall, or the number of seats affect the relative variation in the reverberation time accord the number of occupied seats. The present work gives, in the of equations and charts, an easy way to do this.

9461 ACOUSTIC TREATMENT OF THE CLEVELAND PUBLIC AUDITORIUM. J.Hunter and H.R.Mull.
J. Acoust. Soc. Amer., Vol. 33, No. 6, 760-6 (June, 1961).

The main arena is one of the largest listening chambers world. Built in the early 1920's, criticism of its acoustic qu had existed from its opening, but had increased rapidly since and in 1955 the city administration called for a thorough stud its acoustic qualities and recommendations for improvement

consists of a description of the initial acoustic study, includ-
ticulation testing and reverberation time measurements, the
ms involved in the acoustic treatment, the actual application
treatment, and opinions of users since completion.

52 ACOUSTIC PROPERTIES OF ANECHOIC CHAMBER.
N.Olson.
ust. Soc. Amer., Vol. 33, No. 6, 767-70 (June, 1961).
easurements have been made on the performance of an an-
chamber built for the National Research Council of Canada,
ng the inverse square law as the criterion of performance.
deviations from the inverse square law were observed, and
were correlated with vibrational modes in the wedge bearing
walls. It was shown that maximum amplitudes of vibration
in certain regions of the walls and occupy frequency ranges
coincide with frequency ranges for maximum deviations from
verse square law. The phase of the vibrations along the walls
in the same manner as the phase of the incident sound wave
room. Blocking all experimental points in one of the walls
ved room response by a small but consistent amount. Treating
s of maximum vibration in the walls as extended sources and
ning contributions from these with the sound field of the
in the room, it was possible to construct room characteristics
r to those observed.

63 NORMAL MODE INTERPRETATION OF THE SOUND
PROPAGATION IN WHISPERING GALLERIES. Y.Satô.
(GB), Vol. 189, 475-6 (Feb. 11, 1961).
n analysis based on the "Normal Mode Theory" of sound
gation is developed which is in accord with the "ray theory"
reation given by Rayleigh (1896). The author assumes that
llery in St Paul's Cathedral is bounded by an approximately
spherical wall and obtains an expression for the radial
ity distribution. Calculations from this agree approximately
he observed auditory characteristics indicating that a kind of
wave exists in the gallery. J.D.Rands

OPTICS . PHOTOMETRY

54 OPTICS OF ALL WAVELENGTHS [Optik aller Wellen-
längen]. Edited by P.Görlich and R.Tiedeken.
: Akademie-Verlag (1959) 395 pp.
or abstracts of papers presented at the above meeting, see
1260, 1808-13, 1821, 1826-7, 2436, 2451, 2579-80, 2702,
2841, 2850, 2860-4, 3795, 4108, 4296, 4358, 4373, 4425-6,
, 4442-4, 4447, 4453, 4457, 4461, 4470, 4483, 4488-9, 4917,
5349 of 1961.

65 VELOCITY OF LIGHT IN A MAGNETIC FIELD.
T.Erber.
(GB), Vol. 190, 25-7 (April 1, 1961).
discussion of experimental possibilities relating to the
vation of certain nonlinear quantum mechanical effects. The
m analogue of the Cotton—Mouton effect should be accessible
ulse-imploded magnetic fields of the order of 3×10^7 G.
possibilities considered include the refraction of light, inter-
etric experiments, dispersion effects, and the conversion of
ty shifts to frequency shifts.

OMOGRAPHIC SOLUTION OF THE FORMULA FOR THE
OF LIGHT SIGNALS. See Abstr. 9234

GEOMETRICAL AND INSTRUMENTAL OPTICS SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

9466 TOTAL REFLECTION AND BACKWARD RADIATION FROM "SECONDARY SOURCES" ACCORDING TO HUYGENS' PRINCIPLE. A.Metz.
C.R. Acad. Sci. (France), Vol. 252, No. 10, 1429-30 (March 6, 1961). In French.

Refers to a series of earlier papers (see, for example, Abstr. 11916 of 1959). In these papers the author showed that in certain cases, notably those involving movement of the medium, sound waves or light waves cannot pass from one medium into another and therefore it is deduced that total reflection takes place. The author now questions this deduction and states that for a long time it has been assumed that Huygens' secondary waves are not propagated backwards. This is erroneous, they radiate in all directions. He concludes "All wave motion which has commenced to propagate has a tendency to continue to propagate in the same direction". He applies this principle to the cases of total reflection from a mirror, and total reflection in the study of refraction. A.B.Wood

9467 COMPARISON OF REFLECTION METHODS FOR MEASURING OPTICAL CONSTANTS WITHOUT POLARIMETRIC ANALYSIS, AND PROPOSAL FOR NEW METHODS BASED ON THE BREWSTER ANGLE. S.P.F.Humphreys-Owen.
Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 949-57 (May, 1961).

The pairs of observations at non-normal incidence which specify the various reflection methods of determining the optical constants n and k are compared as to their arithmetical sensitivity to changes in n and k and hence as to their theoretical suitability. Only the simple methods which do not require polarimetric analysis are considered. The comparison of sensitivity is done by inspection of charts prepared from computed tables and which cover a wide range of n and k. A previously unnoticed property of the Fresnel equations at 45° incidence allows any method, not just one in which a ratio of reflectivities is measured, to be employed without a standard reflector. Experimental factors as well as theoretical sensitivity are considered, and the use of the Brewster angle as one observation is proposed. An exact analysis of the Brewster condition is made, which leads to explicit equations applicable to two proposed methods. The distinction between the Brewster angle and the principal angle of incidence, which are often confused, is emphasized

RESOLVING POWER AND IMAGE QUALITY.
See Abstr. 9494

9468 CONTRAST AND IMAGE QUALITY MEASURED BY THE DOUBLE STAR METHOD. A.Lohmann.
Hausmitt. Jos. Schneider (Germany) Vol. 12, No. 9-10, 97-111 (1960). In German.

A Siemens star (radial line test-object) is imaged by means of the optical system under test on an identical pattern. The light transmitted is sent to a photocell, and the modulation M_{SS} produced, when one star is rotated, is measured. It is shown that M_{SS} is approximately a mean of the contrast transfer function weighted as the inverse cube of the spatial frequency. A modification of the test to change this weighting factor to the inverse square is suggested. W.T.Welford

9469 REFRACTOMETER MEASUREMENTS OF SOME MEDICINAL SUBSTANCES. R.Fonzari.
Atti Fond. Ronchi (Italy), Vol. 15, No. 5, 453-6 (Sept.-Oct., 1960). In Italian.

A simple refractometer for the determination of refractive index of liquids is described. Results are quoted for a number of oils and essences used in medicine. Comparison of results with glycerine/water mixtures and standard values illustrate the accuracy of the equipment. R.W.Fish

9470 RAPID METHOD FOR INTERPOLATING REFRACTIVE INDEX MEASUREMENTS. O.N.Stavroudis and L.E.Sutton.

J. Opt. Soc. Amer., Vol. 51, No. 3, 368-70 (March, 1961).

A two-term Sellmeier formula having four parameters is fitted by least squares to the data by an iterative process on an IBM 704 computer. In a trial run of four iterations on the data of a material of low refractive index, a fit to $\pm 3.5 \times 10^{-4}$ in n was obtained over the wavelength range 0.26 to 10.3μ. W.T.Welford

9471 VARIABLE FOCAL LENGTH MIRRORS.

J.C.Muirhead.

Rev. sci. Instrum. (USA), Vol. 32, No. 2, 210-11 (Feb., 1961).

An aluminized Mylar film is stretched across a drum, forming a plane mirror. Application of pressure or suction to the drum deforms the film into a convex or concave mirror surface, whose focal length can be controlled by the air pressure. A typical mirror 4 ft in diameter is illustrated. R.W.Fish

9472 METAL MIRRORS WITH HIGH REFLECTION COEFFICIENTS. É.I.Levitina.

Optika i Spektrosk. (USSR), Vol. 10, No. 1, 135-8 (Jan., 1961). In Russian.

The reflection coefficients of chromium, nickel, palladium, rhodium and aluminium mirrors were raised considerably by coating them with $Si-TiO_2$ layers deposited by hydrolysis of orthosilicic and orthotitanic acids. For example, the reflection coefficient of chromium mirrors was raised from 50-53% to 65-67% and for aluminium mirrors it was raised from 88-89% to 91-92%. [English translation in: Optics and Spectrosc. (USA), Vol. Vol. 10, No. 1, 66-8 (Jan., 1961)]. A.Tybulewicz

9473 A SCANNING INSTRUMENT FOR THE MEASUREMENT OF OPTICAL FREQUENCY RESPONSE. K.G.Birch.

Proc. Phys. Soc. (GB), Vol. 77, Pt 4, 901-12 (April, 1961).

The instrument measures alternatively the distribution of intensity in the image of a narrow slit (the spread function), or the frequency response function, which latter is the Fourier transform of the spread function. For the former, a slow scan with an exploring slit is used, while for the direct determination of the frequency response curve, a continuous scanning with a grating of slits arranged around the periphery of a variable speed drum is employed with a single frequency electrical detector. The in-focus aberration-free image of a line source was measured together with the axial variation of central intensity and good agreement with the theoretical curves was obtained. The frequency response curves obtained by taking the Fourier transforms of four out-of-focus spread functions numerically agreee well with the direct determinations of the frequency response with the scanning drum. Further the frequency response curves for a well corrected lens in different focal planes were compared with results obtained by Hopkins theoretically (1953).

9474 PHOTOELECTRIC LUXMETER FOR THE NEAR INFRARED RANGE OF THE SPECTRUM.

V.I.Zhuravlev and I.L.Zel'manovich.

Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 98-9 (Nov.-Dec.). In Russian.

The instrument consists of a silver sulphite photocell with maximum response at 0.9 μ and a microammeter and resistor. It is calibrated in "equivalent lux", i.e. the illumination in lux from standard source A used for the calibration. Allowance is made for the temperature coefficient, 0.8% decrease in current per deg. rise. For proportionality between photocurrent and illumination the resistance of the microammeter should not exceed the internal resistance of the photocell. Several illumination-response curves are given, as well as a spectral sensitivity curve for the photocell. [English translation in: Instrum. exper. Tech. (USA), No. 6, 955-6 (Nov.-Dec., 1959; publ. Sept., 1960)]. J.W.T.Walsh

9475 CALIBRATION OF INFRARED PRISM SPECTROMETERS. A.S.Filler and L.Indyk.

J. Opt. Soc. Amer., Vol. 51, No. 5, 572-4 (May, 1961).

The dependence of frequency ν on the setting T of an infrared prism spectrometer can be given by the formula $\nu(T) = A(T) + B/(C-T)$ with a small variation of the parameter A. For prisms in their lowest octave of transmission the variation in A is 10 cm^{-1} for NaCl, and 2.5 cm^{-1} for KBr and CsI. For a KBr prism in a double-pass instrument enough atmospheric absorption lines are resolved to give adequate reference data for calibration without using any other gas. Frequencies for this purpose are given.

9476 A NEW PLANE GRATING SPECTROGRAPH.

P.Kröplin.

J. sci. industr. Res. (India), Vol. 19A, No. 7, 308-10 (July, 1960)

This Zeiss instrument gives a flat spectrum by using a larg concave aluminium mirror as collimator and telescope objective and a blazed grating 7 cm wide by 5 cm high having 600 lines/m Analytical work is made largely automatic by mechanisms opera the cassette movement, the slit adjustment, and the exposure tim Dispersion, resolution, and distribution of light in spectrum orde are discussed. S.T.Hende

9477 A TIME-RESOLVED SPECTROGRAPH FOR USE WI TRIGGERED LIGHT SOURCES.

F.L.Curzon and J.R.Greig.

J. sci. Instrum. (GB), Vol. 38, No. 6, 239-41 (June, 1961).

Details are given of a time-resolved spectrograph with writing speeds up to 5 mm/μs (at f/12) which can be used to view weak light sources. The main limitation is that the light source must be able to be triggered reproducibly. This is necessary as the increased effective light intensity needed to obtain a usable image density in the camera of the spectrograph is produced by the accurate superposition of the light of many discharges. An experiment is described which shows that the superposition of fifty successive discharges was achieved with an overall variatio of less than 0.3 μs.

9478 MECHANICAL SPECTROGRAPH SHUTTER FOR EXPOSURE TIMES UP TO 1 μsec.

R.Schneider and M.Mailänder.

Z. angew. Phys. (Germany), Vol. 12, No. 11, 521-5 (Nov., 1960). In German.

The shutter consists of a thin aluminium disk rotating at 25,000 rev/min; the disk is provided with a single radial slit. A spring-loaded disk with a fairly wide window slit is mounted co-axially with the first and on release permits one exposure to take place, when the slits are in coincidence. An auxiliary light path and photo-cell arrangement is used to synchronize the shutter with the light source. Other photocells are used to mea the exposure time and check performance generally.

A.E.I. Research Laborat

9479 THE NECESSITY OF PROTECTING SPECTROGRAPHS FROM DISPERSED DAYLIGHT DURING L EXPOSURES. N.K.Bel'skii.

Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 132 (Nov.-Dec.). In Russian.

Spectra of dispersed daylight were recorded using a wide spectrograph slit and long exposure. The solar spectrum is noticeable after 15 mins. exposure. [English translation in: Instrum. exper. Tech. (USA), No. 6, 988-9 (Nov.-Dec., 1959; pub Sept., 1960)]. G.I.W.Llew

9480 AN ANNULAR LOW-PRESSURE MERCURY LAMP.

I.I.Kondilenko and G.A.Vorob'eva.

Optika i Spektrosk. (USSR), Vol. 9, No. 4, 524-5 (Oct., 1960). In Russian.

Describes a lamp used to excite Raman spectra. It consist of two coaxial horizontal glass cylinders. A cell with the test substance was placed in the inner cylinder. The annular gap between the outer and inner cylinders was connected by means glass tubes to two liquid-mercury water-cooled electrodes. A auxiliary liquid-mercury electrode was used to strike an arc a cathode. Then the discharge was extended throughout the annu gap by touching the outer cylinder with an electrode of an 80kc oscillator. A voltage of 110 V a.c. was applied to the lamp and it worked best at currents of 6-25A. [English translation in: Optics and Spectrosc. (USA), Vol. 9, No. 4, 273-4 (Oct., 1960)]. A.Tybu

9481 ARC LAMP INTENSITY STABILIZER.

D.Redfield.

Rev. sci. Instrum. (USA), Vol. 32, No. 5, 557-8 (May, 1961).

An instrument was developed which readily stabilizes to w 0.1% the intensity of a well-defined beam originating in a high pressure xenon arc lamp. Fluctuations due to changes in curr or arc position are compensated by a shunt-type regulator conn across the lamp.

PHYSICAL OPTICS

*(Luminescence is included under Solid-State Physics,
Liquid State, or Gaseous State)*

82 DEPTH OF PENETRATION AS A MEASURE OF REFLECTIVITY OF THIN CONDUCTIVE FILMS.
Koide.
Inst. Radio Engrs (USA), Vol. 48, No. 9, 1654-5 (Sept., 1960).
The depth of penetration δ is a measure of the power of a wave
netrate into a conducting medium. If a film has thickness
derably less than δ, its reflecting power is considerably less
he normal value. A multiplying factor is calculated which
applied to δ gives the thickness of film needed to give 90% of
ormal reflection. P.M.Davidson

483 [LIGHT] INTENSITY DISTRIBUTION IN SPACE OF WEDGE INTERFERENCE FRINGES.
ulz and G.Minkwitz.
Phys. (Germany), Vol. 7, No. 7-8, 371-80 (1961). In German.
Two-beam fringes are formed in perfectly monochromatic light
llimated beams from a source of finite angular extent 2u, as in a
nated Michelson or a Mach—Zehnder interferometer. The
ndence of fringe visibility and phase on the position in space
ive to the wedge apex, i.e. the virtual intersection of the
ors in the Michelson, and on the angle u, is calculated.
W.T.Welford

484 OPTICAL DEMONSTRATION OF BRAGG'S LAW. W.G.Burgers.
re (GB), Vol. 189, 741 (March 4, 1961).
A fine-grained photographic plate was exposed to monochro-
c light with its emulsion in contact with mercury; some
onstration experiments using this plate are described.
A.R.Stokes

485 DIFFRACTION OF LIGHT BY VERY HIGH FREQUENCY ULTRASONIC WAVES.
machandra Rao and J.Satyanarayana Murty.
. Phys. Soc. (GB), Vol. 77, Pt 5, 958-64 (May, 1961).
Embodies the results of diffraction by u.s. waves in the range
to 230 Mc/s. Intensity measurements were made by using a
y sensitive photomultiplier photometer. Results of the
tion of the intensity of the first order of the diffraction
rn with the tilt angle for weak sound fields agreed equally well
both the theories of David (1937) and that of Bhatia and Noble
). Measurement of the intensity variation of the first order
length of the sound field at the Bragg incidence angle showed
only the theory of Bhatia and Noble is valid for stronger sound
s.

486 MEASUREMENT OF THE ANGULAR VARIATION OF LIGHT SCATTERED FROM SINGLE AEROSOL
PLETS. F.T.Gucker and J.J.Egan.
olloid Sci. (USA), Vol. 16, No. 1, 68-84 (Feb., 1961).
An instrument was constructed to measure the intensity of
scattered at various angles from a single droplet of dioctyl
ılate of about one micron radius or larger, illuminated by
ation of 436 millimicrons wavelength. The general principle
e measurement is to suspend a charged particle between
electrostatic plates, illuminate it with a parallel beam of
ochromatic light, and measure with a sensitive photometer
ight scattered at various angles from the incident beam.
ering curves for four particles varying in size from 0.7 to 1.5
ons radius are presented and compard with curves calculated
Mie's electromagnetic theory. In general the agreement is
factory.

487 THEORY OF OPTICAL ACTIVITY OF MOLECULES, POLYMER CHAINS AND CRYSTALS. S.Venkataraman.
turforsch. (Germany), Vol. 16a, No. 4, 356-62 (April, 1961).
The polarizability theory of optical activity is fully worked out
sor notation, giving formulae for birefringence and optical
ty of a crystal kept in an arbitrary orientation in a beam of
It is shown that the theory so developed can also be applied to
nple molecule or a polymer chain of fixed orientation, with
minor modifications. Compact formulae are obtained for these
, which also bring out the idea of "coupled oscillators" for the
rence of optical activity. The formulae can also be averaged
all orientations and this leads to an expression for the specific
on of a solution of a polymer containing helical chains.

9488 LAWS OF COMBINATION OF BIREFRINGENCE; APPLICATION TO THE MAXWELL EFFECT IN POLY-DISPERSED SYSTEMS. J.Leray, G.Scheibling and C.Sadron.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1748-9 (March 20, 1961).
In French.

Equations are derived for the combination of two birefringent films. These are shown to be equivalent to a single birefringent film coupled with an optically active film. For weak birefringencies, these can be obtained by summing two vectors. Applying the result to macro-molecular solutions, the classical formulae for the Maxwell effect are derived. R.W.Fish

COLORIMETRY . PHOTOGRAPHY

COLOUR-ORDER SYSTEM PREDICTING CONSTANT HUE.
See Abstr. 9237

9489 THE DEVELOPMENT OF SCIENTIFIC PHOTOGRAPHY IN PRE-REVOLUTIONARY AND SOVIET RUSSIA.
K.V.Chibisov.
Photogr. J. (GB), Vol. 101, No. 5, 129-48 (May, 1961).

Extensive contributions made by early Russian workers in the fields of invention and technology are reviewed; and the later achievements of Soviet scientists in photographic chemistry, physics, and industry are outlined. Specific subtitles include: (1) first steps in the development of photography in Russia; (2) research in the photographic process; (3) application of photography to science and technology; (4) advances in Soviet photographic science; (5) testing of photographic emulsions; and (6) photography in Soviet science and technology. A valuable bibliography of 99 items follows. D.R.Barber

9490 FURTHER EXPERIMENTS WITH MICROWAVES ON THE MECHANISMS OF PHOTOGRAPHIC IMAGE FORMATION.
I.S.Ciccarello, L.Cordone, A.Orlando and M.U.Palma.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 89-94 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). The two stages of the Mitchell theory (Abstr. 2087 of 1958) of photographic processes, which are concerned with the trapping of the photoproduced positive holes, were investigated in AgCl containing CuCl impurities and in AgBr containing $CdBr_2$ impurities. In both cases, experimental evidence is given for the operation of the mentioned stages. After the trapping of the holes, pairs of defects (interstitial silver ions and cation vacancies) are created, in positions nearest to the impurity. This happens also in the case of Cd^{2+} impurities and gives rise to unexpected phenomena which are attributed to dielectric relaxation. The hypothesis that an association of holes and vacancies occurs is consistent with the present experiments, although no e.s.r. signal from such centres was detected.

9491 EVAPORATED SELENIUM FILMS FOR USE IN Hα PHOTOGRAPHY. W.A.Feibelman.
Publ. Astron. Soc. Pacific (USA), Vol. 72, 510-11 (Dec., 1960).

Evaporated amorphous selenium films 1 micron thick have an absorption edge at 6000 A and a transmission of 50% at 6500 A. Used as optical filters in conjunction with Kodak 103a-E emulsion which has little sensitivity at wavelengths greater than 6600 A, such films could be used for Hα photography with Schmidt telescopes.
D.L.Greenaway

9492 THE DETERMINATION OF THE DISTRIBUTION OF SENSITIVITY IN PHOTOGRAPHIC EMULSIONS.
E.Klein and E.Moisar.
Naturwissenschaften (Germany), Vol. 48, No. 1, 23-4 (1961). In German.

The use of emulsions of narrow range in grain size confirmed the work of Haase (Abstr. 19466 of 1960), who demonstrated a logarithmic normal distribution of sensitivity among the grains.
S.T.Henderson

9493 CONCERNING THE POSSIBILITY OF NON-UNIFORM SHRINKAGE OF FILMS. H.Weyerer.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 115-16 (March, 1961).
In German.

The possibility of non-uniform film shrinkage was investigated experimentally for X-ray fine structure applications by copying a system of 50-100 accurately measured line marks at 1 mm intervals onto the cut films before their development. The films were developed, fixed and washed in a reproducible manner and then slowly dried in air. The line separation was re-measured independently by three observers with a mean error of ± 0.003 mm. A number of different photographic materials were tested, cut in various directions and sizes, some with punched holes. Any uneven film shrinkage was found to be indistinguishable from the inaccuracy of displacement measurement, whereas the mean uniform film shrinkage amounted to 0.1_3 %. W.Steckelmacher

9494 RESOLVING POWER AND IMAGE QUALITY.

G.Franke.

Hausmitt. Jos. Schneider (Germany), Vol. 13, No. 3-4, 34-41 (1960-1961). In German.

A survey of testing methods for photographic objectives, including contrast transfer, resolution and the line spread function.

W.T.Welford

9495 FLASH-TUBE LIGHTING IN SCIENTIFIC CINEMATOGRAPHY. J.Rieck.

Lichttechnik (Germany), Vol. 13, No. 4, 173-6 (April, 1961). In German.

Describes the characteristics of the lamps and circuits used for scientific cinematography at normal speeds (24 frames per sec.) and high speeds (8000) and for such work as the study of plant behaviour. At normal speeds it is possible to trigger any desired number of tubes practically simultaneously to obtain a higher illumination. J.W.T.Walsh

9496 CAMERA RKS-1 FOR HIGH-SPEED CINEMATOGRAPHY. S.M.Provornov and O.F.Grebennikov.

Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 104-7 (Nov.-Dec.). In Russian.

A high-speed raster camera with a frequency over 10^8 frames/sec is described. The theory of operation is given, together with practical details such as synchronization necessary for successful operation. Some typical frames are illustrated. [English translation in: Instrum. Exper. Tech. (USA), No. 6, 961-4 (Nov.-Dec., 1959; publ. Sept., 1960)]. R.W.Fish

9497 SMEAR CAMERA TECHNIQUE FOR FREE-SURFACE VELOCITY MEASUREMENT. W.C.Davis and B.G.Craig.

Rev. sci. Instrum. (USA), Vol. 32, No. 5, 579-81 (May, 1961).

An optical technique which permits recording the position of a very small region of a surface as a function of time is described. The surface must reflect light specularly, the arrangement must allow some space in front of the surface, and the radius of curvature of the surface must be large compared with the distance over which the position is of interest. There are no other restrictions on the surfaces to which the technique may be applied. The apparent position of the image of an object reflected in the free surface to be studied is recorded with a moving image smear camera, and velocity is obtained from the record of position as a function of time. This technique was used to measure velocities between 5×10^3 and 5×10^5 cm/sec in times as short as 3×10^{-8} sec for research with high explosives.

9498 THE PHOTOGRAPHIC BLACKENING LAW FOR ELECTRON BEAMS OF VARIOUS ENERGIES.

R.Glocker.

Z. Phys. (Germany), Vol. 160, No. 5, 568-72 (1960). In German.

Considers the problem of evaluating the blackening effect of incident electrons on a photographic emulsion whose thickness is less than the range of the electrons. It is shown that equal amounts of absorbed energy give equal blackening irrespective of the energy of the incident electrons within the range 100 to 2000 keV.

A.E.I. Research Laboratory

HEAT . RADIATION

9499 STEADY TEMPERATURE FIELD IN A COMPOSITE DOUBLY INFINITE STRIP. V.Vodička.

J. Phys. Soc. Japan, Vol. 15, No. 7, 1232-6 (July, 1960).

Extends the classical results on two-dimensional stationary temperature distribution in an infinite plate to the case of a composite strip. General deductions are applied to some special cases leading to new results not given in the literature.

9500 DETERMINATION OF CHARACTERISTIC THERM
DATA OF BAD THERMAL CONDUCTORS BY MEA
OF A TWO PLATE APPARATUS WITHOUT GUARD RING.

W.Knappe.

Z. angew. Phys. (Germany), Vol. 12, No. 11, 508-14 (Nov., 196
In German.

In the apparatus described the usual massive hot plate is
replaced by a 10 μ thick strip of constantan through which an
electric current is passed. The specimens are 8 cm square p
of 3 to 12 mm thickness. The thermal conductivity is determi
from steady state measurements with a temperature differenc
2°C across the specimen and the film coefficient from non-ste
state measurements. Measurements were made on different t
of plastic materials with conductivities of the order of 10^{-4} cal
cm^{-1} sec^{-1} deg^{-1}C over the range of temperature 0-100°C.

S.Weir

9501 SOME POSSIBLE COMPLICATIONS IN THE PHEN
ENA OF THERMAL CONDUCTION. P.Vernotte.

C.R. Acad. Sci. (France), Vol. 252, No. 15, 2190-1 (April 10, 1
In French.

Former work (Abstr. 3373, 6505 of 1959) indicated the nec
for replacing the classical heat equation by the so-called equat
telegraphy. It is now shown, as a consequence of mechanical p
cesses involved in conduction and explicable by kinetic theory,
the Fourier law should be modified by the introduction of a ter
volving inertia.

H.H.Ho

9502 IMPROVEMENT IN INFRARED DETECTOR PERF
ANCE THROUGH USE OF ANTIREFLECTION FIL

W.A.Farber, P.W.Kruse and W.D.Saur.

J. Opt. Soc. Amer., Vol. 51, No. 1, 115 (Jan., 1961).

The semiconductors which are used for infrared detectors
a high refractive index, so that an appreciable fraction of the
tion incident on the detector is reflected. The performance of
detector can be improved by the use of a reflection-reducing
Results are given for InSb PEM cells coated with an evaporate
layer of ZnS.

C.

PHOTOELECTRIC LUXMETER FOR THE NEAR INFRA
RANGE OF THE SPECTRUM. See Abstr. 9474

MEASUREMENT OF PARTICLE AND GAS TEMPERATU
IN A SLIGHTLY LUMINOUS PREMIXED FLAME. See Abstr.

9503 A SIMPLE LABORATORY THERMOSTAT WITH
SMALL THERMAL INERTIA.

O.V.Emel'yanenko and T.S.Lagunova.

Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 130 (Nov.-Dec.)
In Russian.

The thermostat consists of a vertical glass tube with dou
walls and two inside manganin heaters. The tube is placed in
Dewar flask filled with liquid nitrogen, with the upper heater
the surface of the liquid. The immersed lower heater produc
stream of evaporating nitrogen. The space above the upper h
is the operative part of the thermostat. By adjustment of the
heater stable temperatures in the range −196° to 100°C can b
attained and by using an additional furnace the range can be exter
400°C. Both air and vacuum between the double walls were t
the times to reach equilibrium were 3 to 5 min. and 2 to 3 mi
respectively, and the corresponding expenditures of nitrogen
< 1 l/hr and 0.1 to 0.5 l/hr. [English translation in: Instrum
exper. Tech. (USA), No. 6, 986-7 (Nov.-Dec., 1959; publ. Sept
1960)].

S.We

9504 A SIMPLE DEVICE FOR DIFFERENTIAL ENTH
ANALYSIS. J.L.Petit, L.Sicard and L.Eyraud.

C.R. Acad. Sci. (France), Vol. 252, No. 12, 1740-2 (March 20
In French.

A simpler type of apparatus derived from the Calvet calori
(Abstr. 1883 of 1949) is described with diagrams, which enab
linear recording of thermal changes to be rapidly made betw
±150°.

H.H.

CHANGE OF STATE

(Solid-state phase transformations are included primarily under Structure of Solids)

5 A PSYCHROMETER TABLE FOR HEAVY WATER HUMIDITIES. C.D.Niven.
J. Phys., Vol. 39, No. 6, 825-9 (June, 1961).
table for use in atmospheres humidified with heavy water
nstructed by calculation from data on the vapour pressure
ent heat of vaporization of heavy water, between 10° and
The relative humidity is quite markedly lower in the low
ature end of this range when heavy water is used instead of
ry water, for the same wet and dry bulb readings.

6 VAPORIZATION OF IRIDIUM AND RHODIUM. M.B.Panish and L.Reif.
m. Phys. (USA), Vol. 34, No. 6, 1915-18 (June, 1961).
he vaporization of iridium and rhodium was studied by
en effusion and Langmuir evaporation techniques. The
pressure of iridium over the temperature range of from
to 2600°K is represented by the equation:
m = 10.46 – (33980/T), and the vapour pressure of rhodium
he temperature range of from 2050° to 2200°K by the equation:
m = 10.28 – (28300/T). Third-law analyses of the data yield
lowing heats of vaporization: iridium, $\Delta H_{298} = 158.4 \pm 0.5$
nole; rhodium, $\Delta H_{298} = 132.8 \pm 0.3$ kcal/mole. Estimated
points for iridium and rhodium are 4800° and 3980°K,
ctively.

07 DETERMINATION OF THE HEAT AND ENTROPY OF FUSION OF FLUORITE, BY THE CRYOMETRIC
OD AT HIGH TEMPERATURE (> 1400° C). F.Delbove.
cad. Sci. (France), Vol. 252, No. 15, 2192-4 (April 10, 1961).
nch.
o avoid possible oxidation this determination was carried
purified argon for solutions of LiF, NaF, KF, KCl, BaF_2,
and AlF_3 in fused CaF_2, and a cryometric technique developed,
peratures not hitherto attained, to give fusion point depres-
accurate to one tenth of a degree above 1400° C. The heat and
y of fusion for CaF_2 are found to be 7250 ± 350 cal and
0.2 per mol respectively. H.H.Hodgson

LOW-TEMPERATURE PHYSICS

08 THEORY FOR THE OPERATION OF A MAGNETIC REFRIGERATOR AT TEMPERATURES BELOW 1° K.
rdon and H.B.Silsbee.
ci. Instrum. (USA), Vol. 32, No. 5, 572-8 (May, 1961).
theory for determining the optimum cycle of a magnetic
erator is developed. The refrigerator consists of a helium
paramagnetic working substance, and an isothermal
voir. The working substance is connected to the bath and to
servoir via thermal valves. In the theory the valves are
med to be superconducting wires, but no assumptions are made
rning the characteristics of the working substance. The
ed behaviour of a refrigerator utilizing both He^4 and He^3
is investigated. It is predicted that a magnetic refrigerator
ing from a bath temperature of 0.3° or 0.4° K will be able to
in an isothermal reservoir temperature of 0.05° K or lower
eat inputs of 10-20 ergs/sec, providing the effects of thermal
t resistance can be kept small. The effect of thermal
ance on refrigerator performance is investigated. The same
tical techniques have been used to predict the behaviour of a
tic refrigerator utilizing a mechanical switch. In the paper
oretical and experimental results are compared. Moderately
greement is obtained.

DIABATIC DEMAGNETIZATION IN A ROTATING
RENCE SYSTEM. See Abstr. 9060

id and Solid Helium

9 THE EFFECT OF A DENSITY MAXIMUM NEAR THE λ POINT ON THE TEMPERATURE DISTRIBUTION IN
) HELIUM I. C.E.Chase, E.Maxwell and W.M.Whitney.
a (Netherlands), Vol. 26, No. 3, 160-2 (March, 1960).
king reasonable assumptions, the thickness of the layer which is developed at the temperature of density maximum, and which prevents heat transport by convection, its rate of movement and the temperature gradient are calculated. Experimental results appertaining to the temperature difference between the top and bottom of a can containing liquid helium, cooling by heat flux through the liquid surface, showed a very abrupt increase in the temperature difference as the λ point was approached by the top of the can, with the maintenance of a large gradient for about four minutes, after which the temperature of the can bottom fell abruptly. These results suggest the passage of a steep temperature front as described. F.E.Hoare

Superconductivity

9510 SIGN REVERSAL OF THE MAGNETIC FIELD IN THE MEISSNER EFFECT. II. DIFFUSE SURFACE SCATTERING [OF ELECTRONS]. R.Sommerhalder and H.Thomas.
Helv. phys. Acta (Switzerland), Vol. 34, No. 3, 265-71 (1961).
In German.

For Pt I see Abstr. 8283 of 1961. The calculation of the penetration of a longitudinal magnetic field through the wall of a superconducting hollow cylinder, according to Pippard's non-local theory with specular reflection of the electrons at the surfaces, is extended to cover the case of diffuse scattering of the electrons at the surfaces. It is shown by numerical analysis that the wall thickness, above which the magnetic fields inside and outside the hollow cylinder have different signs, is about 750 A larger, and the maximum field attenuation ratio available for experimental detection of the sign reversal about twice as low, for diffuse as for specular surface scattering. Both results do not depend upon the value of the coherence length. Because of the strong similarity between the BCS and Pippard kernels, these results should also be fairly representative for the BCS-theory.

9511 ON THE PROBLEM OF THE EXISTENCE OF SUPERCONDUCTIVE STATE IN ANTIFERROMAGNETIC METALS. B.V.Karpenko.
Fizi. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 794-5 (May, 1960). In Russian.

The absence of superconductivity in antiferromagnetic metals is explained analytically in terms of the effect of the interaction between the conduction electrons and spin waves on the onset of superconductivity. M.H.Sloboda

9512 ON THE QUESTION OF THE EXISTENCE OF SUPERCONDUCTING ANTIFERROMAGNETICS.
B.V.Karpenko.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 301-2 (Aug., 1960). In Russian.

The effect of the inelastic scattering of electrons on magnons in causing superconductivity to appear in antiferromagnetics is investigated by Bogolyubov's method (see Abstract 8158 of 1959). The ordinary form of the Hamiltonian of the system electrons—phonons—spin waves is changed by using Bogolyubov's transformation. Then the equation of compensation of processes of simultaneous creation of certain Cooper pairs is obtained and solved by Tolmachev's method (see the same abstract). This leads to the value of the energy gap between the first excited state and the ground state. N.Davy

9513 SUPERCONDUCTIVITY OF Nb_3Sn IN PULSED FIELDS OF 185 KILOGAUSS.
V.D.Arp, R.H.Kropschot, J.H.Wilson, W.F.Love and R.Phelan.
SUPERCONDUCTIVITY OF Nb_3Sn IN A PULSED MAGNETIC FIELD.
J.O.Betterton, Jr, R.W.Boom, G.D.Kneip, R.E.Worsham and C.E.Roos.
Phys. Rev. Letters (USA), Vol. 6, No. 9, 452-3 (May 1); No. 10, 532-4 (May 15, 1961).

Both groups used Nb_3Sn wires encased in Nb tubes ~0.4 mm in diameter, as described by Kunzler et al. (Abstr. 5399 of 1961), and determined the resistance by passing a square current pulse at the peak of the field pulse. In a longitudinal field, at 4°K, Arp et al. found a critical current I_C of 5 A at 160 kG, and a critical field H_C of 165 kG; at 1.6°K, H_C = 188 kG. Betterton et al., at 4°K, found $I_c \sim 250$ A in zero field, falling to 100 A at 90 kG and 20 A at 130 kG for longitudinal fields, and 100 A at 30 kG and 20 A at 40 kG for transverse fields. R.G.Chambers

9514 SUPERCONDUCTING TUNNELING ON BULK NIOBIUM. M.D.Sherrill and H.H.Edwards.
Phys. Rev. Letters (USA), Vol. 6, No. 9, 460-1 (May 1, 1961).

Tunnel currents were measured on a Nb—NbO—Pb sandwich

formed by evaporating Pb on to vacuum-annealed bulk Nb. It is concluded that at 1.9°K the energy gap in Nb is 3.59 kT_c (T_c = 9.2°K).
R.G.Chambers

9515 EXPERIMENTAL AND THEORETICAL INVESTIGATION ON THE ONSET OF THE SUPERCONDUCTING–NORMAL TRANSITION UNDER THE INFLUENCE OF A SUPERCRITICAL MAGNETIC FIELD AT DIFFERENT SWITCH-ON VELOCITIES OF THE FIELD. M.Näbauer.
Z. Phys. (Germany), Vol. 163, No. 2, 119-39 (1961). In German.

Confirmation of the investigation of the transition in a monocrystalline hollow lead cylinder under the influence of a toroidal supercritical magnetic field (Abstr. 321 of 1959). Here the effect of the rise time of the magnetic field to a fixed final value is investigated. The earlier investigation had shown discrepancies between theory and experiment during the first 2 msec after the field had passed the critical value at the inner surface of the hollow cylinder, whereas good agreement was obtained after that interval. The present measurements throw further light on these initial deviations, and establish that they are due to inhomogeneities of the magnetic field and of the structure of the surface and not to delays in the nucleation of the normal phase.
H.London

ELECTRICITY

ELECTRICAL MEASUREMENTS AND CIRCUITS

9516 HIGH VOLTAGE MEASUREMENT BY A.D.P. CRYSTAL PLATE. S.Namba.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 595-7 (May, 1961).

High voltage measurement based on the electro-optical effect of A.D.P. crystal plates is described. When a voltage is applied across a uniaxial A.D.P. crystal, the crystal becomes biaxial. For the field E_Z in the Z direction across a Z-cut crystal plate, axes of the index ellipsoid are rotated by −45° in the XY plane independent of E_Z and birefringence along the Z axis becomes proportional to E_Z, then the retardation of light in the Z direction becomes proportional to the applied voltage across the crystal plate. Therefore, the applied voltage can be obtained by photoelectric measurement of the optical retardation.

9517 PULSE-SAMPLING VOLTMETER AND ITS APPLICATION TO TRANSISTOR TESTING.
L.J.Herbst and J.R.W.Smith.
J. sci. Instrum. (GB), Vol. 38, No. 6, 242-5 (June, 1961).

A voltmeter designed for measuring low-frequency transistor current gain under large signal conditions is described. The method consists of sampling a waveform at approximately 100 c/s with a 20 μs pulse, which gates the voltage under test at any required point of the cycle. The segment selected by the pulse is amplified and rectified, its amplitude being determined by a comparison technique in which a variable d.c. voltage is fed to the test set in place of the waveform. The equipment presents an input resistance of at least 200 kΩ on all ranges and measures voltages from 100 mv to 75 v with an accuracy to 1%; the upper limit could be extended.

9518 MEASUREMENT OF THE RESISTIVITY AND HALL'S CONSTANT OF HIGH RESISTANCE SEMICONDUCTORS.
Tszyan Pi-Khuan [Chiang P'i-Huang].
Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 81-2 (Nov.-Dec.).
In Russian.

A detailed description is given of a bridge circuit used for measuring the resistivity and Hall's constant of a semiconductor having a resistivity between 10^2 and 10^9 ohms cm. [English translation in: Instrum. exper. Tech. (USA), No. 6, 939-40 (Nov.-Dec., 1959); publ. Sept., 1960)].
P.A.Walker

9519 NEW QUENCHING CIRCUIT OF HIGH QUENCHING POWER AND HIGH SENSITIVITY. B.Kalab.
J. sci. Instrum. (GB), Vol. 38, No. 6, 253-7 (June, 1961).

A circuit is described which produces rectangular quenching pulses of an amplitude up to 2000 V, variable from zero to the maximum value. The change in voltage across the counter is independent of the counting rate. An amplifier of high gain can b used so that the sensitivity is 0.3 mV. Self-oscillation, due to th voltage rise at the end of the quenching period, cannot appear.

9520 ELECTROLYTIC JUNCTION WITH AMPLIFYING PROPERTIES. B.Lovreček and B.Kunst.
Nature (GB), Vol. 189, 804-6 (March 11, 1961).

A current amplifier using electrolytic elements was made employing a circuit similar to that used in ovitron amplifiers, wi the exception that the metal–metal oxide electrodes are replaced with electrolyte–electrolyte junctions. These junctions have bee described earlier [J. Phys. Chem., Vol. 63, 750 (1959)]. The amplified waveforms are shown for two circuit conditions.
K.N.R.Tay

9521 R.F. GATE WITH 10^9 CARRIER SUPPRESSION. R.J.Blume.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 554-6 (May, 1961).

A 10.7 Mc/s c.w. reference oscillator drives the cathode of planar triode grounded-grid amplifier, which is normally cut off by −20 V on its plate. The grounded planar grid forms a perfor region in the wall of a copper can which otherwise totally shields both the c.w. oscillator and the planar cathode. Radio-frequency energy, which leaks capacitively from that cathode through the grounded grid to the negative plate, is bypassed to ground at the plate through a conducting diode. A positive gate voltage applied the plate switches off the bypass diode and causes the grounded g stage to amplify the r.f. voltage on its cathode. The following po amplifier stage, whose input is d.c. coupled, develops about 100 output during the positive gate. When the gate is off, the output c power amplifier is ≤ 10^{-7} V. The carrier suppression ratio is th fore ≥ 10^9, or 180 dB. The ungated c.w. signal is continuously available. Circuitry, leakage measurement, and shielding are described in detail.

ELECTROSTATICS . DIELECTRIC

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

9522 ELECTROSTATIC PHENOMENON RESULTING FR THE PRESENCE OF SOLID PARTICLES IN AERODYNAMIC FLOWS. P.Couvertier.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1726-7 (March 20, 1
In French.

Describes observations that the solid particles (e.g. talcum aluminium powder) usually used for flow visualization in aerodynamics, can become electrically charged in the course of thei motion, causing solids placed in the flow to be polarized. A description of how this phenomenon may be used as an electrost generator is given, though the figures quoted indicate the proces be singularly inefficient. Thus when a brass sphere of diamete 1 cm was placed in such a flow (at Mach number 0.8), a galvano between the sphere and earth indicated a mean current of 30 μA.
N.C.

THEORY AND DESIGN OF A COAXIAL SUPPORTING BEA MADE OF COMPOSITE DIELECTRICS. See Abstr. 9686

CURRENT ELECTRICITY ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

9523 ON THE CALCULATION OF THE PROPAGATION AN ALTERNATING CURRENT ON THE SURFACE A BODY OF REVOLUTION IN THE PRESENCE OF A STRONG SKIN EFFECT. G.A.Shneerson.
Zh. tekh. Fiz. (USSR), Vol. 31, No. 1, 51-4 (Jan., 1961). In Rus

The solution obtained by Fok (1930) for the problem of the current distribution on the surface of a torus in the presence o a strong skin effect, under the condition that on the surface of the conductor, $H_n = 0$, is now generalized to the case of conduct

s with the same electrical properties, but with any surface
ated by revolution. [English translation in: Soviet Physics–
icas Physics (USA)]. G.Martelli

EMICONDUCTING MATERIALS FOR THERMOELECTRIC
ER GENERATION. See Abstr. 8968

IONIZATION

24 IONIZATION MEASUREMENTS IN SHOCKED GASES.
Y.Manheimer-Timnat.
Res. Counc. Israel, Vol. 8C, No. 1, 53-5 (Feb., 1960).
Experiments to measure the ionization rate in air, argon and
gen were performed by measuring the attenuation of 3 cm
owaves through a shocked gas as a function of time. In air
hock Mach numbers between 8.2 to 10.2) and oxygen with
of nitrogen (for shock Mach numbers between 7.4 to 8.8) the
rimental results for electron density were in close agreement
those predicted from shock wave theory assuming thermal
brium and NO to be the main contributor to the electron density.
rgon experiments showed agreement with the theory only when
ach number of shock was low (~ 7.1). The author suggests
isagreement at higher Mach numbers may be due to the fact
he ionization time of argon is greater than the test time in the
tube used. M.S.Sodha

525 VARIATIONS OF MASS SPECTRA WITH TEMPERATURE BETWEEN –195 AND 200°C. A.Cassuto.
Acad. Sci. (France), Vol. 252, No. 9. 1311-13 (Feb. 27, 1961).
ench.
Analysis of the ions formed by electron collision (energies 50
0 eV) in various noble, diatomic and hydro-carbon gases over
ge of temperatures are reported as verifying the theoretical
mptions of Rosenstock et al. [Proc. Nat. Acad. Sci. USA, Vol. 38,
(1952)]. Detailed results of the variation with temperature
°C to 400°C) of the probability of formation of various ions in
ane are given. The activation energy of the reaction
$+ CH_4 \rightarrow CH_5^+ + CH_3$ is given as zero ± 0.2 kcal between 100 and
K. J.Dutton

526 THE PRODUCTION OF NEGATIVE IONS IN ATOMIC COLLISIONS. Ya.M.Fogel'.
khi fiz. Nauk (USSR), Vol. 71, No. 2, 243-87 (June, 1960).
ssian.
Critical review of experiments on the production of negative
in collisions of ions and atoms with gas molecules, and dis-
on of the applicability of existing theories. Processes of nega-
on production in atomic collisions are divided into two classes
llows. Class I. Capture of one or more electrons from the
ronic structure of a gas molecule by a fast positive ion, repre-
d by

$$A^{k+} + B \rightarrow A^- + B^{(k+1)+} \qquad \text{(I)}$$

II. Production of slow ions, (A) by charge transfer between
ive ions and gas molecules

$$A^- + BC \rightarrow A + BC^- \lessgtr \begin{matrix} B + C^- \\ B^- + C \end{matrix} \qquad \text{(IIA)}$$

y dissociation of a molecule of a gas into positive and negative
by collision with a fast heavy particle

$$A^{k+} + BC \rightarrow A^{k+} + B^- + C^+ \qquad \text{(IIB)}$$

te their importance to radiation chemistry and many other
of physics, processes of class II have not been studied exten-
y and hence the review is mainly devoted to processes of the
class. The review discusses methods for the measurement of
fective cross-sections for production of negative ions in atomic
ions, the results of measurements for processes of Class I (for
and 1), and the following questions: (a) the dependence of the
of the curve of σ(v) (cross-section versus relative velocity) on
ture of the pair of colliding particles; (b) interpretation of the
of σ(v) on the basis of Massey's adiabatic hypothesis, taking
d particles into account; (c) behaviour of curve of σ(v) in high
w velocity regions; (d) dependence of maximum cross-sections
rious factors; (e) comparisons of cross-sections of various
ron-capture processes. Some data on processes of Class II
lso presented. [English translation in: Soviet Physics—Uspekhi
, Vol. 3, No. 3, 390-416 (Nov.-Dec., 1960)]. M.S.Sodha

A POSSIBLE ENHANCEMENT OF RELATIVISTIC INCREASE IN IONIZATION. See Abstr. 8441

THE RELATIVISTIC INCREASE OF THE SPECIFIC PRIMARY IONIZATION IN HELIUM. See Abstr. 8407

ELECTRIC DISCHARGES

9527 THEORETICAL PROOF OF THE "MINIMUM PRINCIPLE" FOR THE VOLTAGE OF A GAS DISCHARGE, WITH CERTAIN OTHER DEDUCTIONS. M.Steenbeck.
Beitr. Plasma Physik (Germany), Vol. 1, No. 1, 1-10 (1960-61). In German.

The bearing of the minimum principle on the steady-state solution of gas discharges is discussed. It is noted that the differential analysis of discharges with fixed boundary conditions is not flexible enough to allow a number of possible stationary solutions. However, by the use of multi-order temperature differentials as approximations to the variations of thermal and electric conductivities it is shown that a final differential equation results which gives the possibility of many stationary states. With such a case the minimum principle becomes useful in allowing a choice of state to be made. It is not decided whether there is a general formula for the principle of choice or whether one must set up a criterion of stability for each individual case. H.Edels

9528 INVESTIGATION OF THE ELECTRIC AND MAGNETIC CHARACTERISTICS OF THE DISCHARGE IN THE APPARATUS "ALPHA". V.A.Glukhikh, D.E.Zavarin, E.G.Komar, B.A.Larionov, N.A.Monoszon, V.V.Skotnikov and A.M.Stolov.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1404-14 (Dec., 1960). In Russian.

For abstract, see Abstr. 4617 of 1961. [English translation in: Soviet Physics—Technical Physics (USA), Vol. 5, No. 12, 1331-9 (June, 1961)].

9529 THE POSITIVE COLUMN OF THE LOW PRESSURE ARGON DISCHARGE IN THE TRANSITION REGION (HOMOGENEOUS TO STRIATED). I. K.Wojaczek.
Beitr. Plasma Physik (Germany), Vol. 1, No. 1, 31-43 (1960-61).

From probe measurements in the positive column, the axial potential gradient is calculated over a wide range of current. Also the electron temperature is calculated in the homogeneous column. Comparison between calculated and theoretical values produced an evaluation of the role of certain elementary processes in the discharge. In the transition region between homogeneous and striated columns, artificially moving layers of small amplitude were excited and the dispersion relationship was measured for various pressures. The dependence of layer thickness and amplification on frequency as determined by the experiment can be given by simple analytic expressions. The results make a quantitative test of the theory of moving layers possible. H.Edels

9530 CORONA DISCHARGES IN ATMOSPHERIC AIR. G.List.
Wiss. Z. Tech. Hochsch. Dresden (Germany), Vol. 99, No. 3, 723-8 (1959-60). In German.

An introductory description of the development and properties of corona discharges is given. The paper describes experiments on positive and negative point-to-plane and wire corona in air. For the positive point a tabulated list is given of discharge phenomenon, character of corona current, appearance of discharge and characteristics of the discharge mechanism. The volt—ampere characteristics, current impulse amplitude, and impulse frequency are plotted for this electrode arrangement. For the negative point—plane arrangement the onset and breakdown voltages, together with the volt—ampere characteristics are plotted for different electrode separations. The breakdown voltage characteristics for positive and negative wires (0.3 mm diameter) are given. For all three electrode araangements colour photographs of the corona are shown. H.Edels

9531 ON THE CONTRIBUTION OF PHOTONS TO THE ELECTRON EMISSION FROM THE CATHODE IN THE MERCURY VAPOUR GLOW DISCHARGE. E.Badareu and F.Wächter.
Ann. Phys. (Germany), Vol. 7, No. 7-8, 418-24 (1961). In German.

The contribution of the photoeffect to the release of electrons from the cathode in a mercury vapour glow discharge is determined experimentally. The contribution is not negligible, amounting in typical cases to some 10%, but this is insufficient to account for the observed current amplification attributed by earlier authors to the photoeffect. A.E.I.Research Laboratory

9532 NEGATIVE OXYGEN IONS FROM A GLOW DISCHARGE SOURCE. W.S.Whitlock and J.E.Bounden.
Proc. Phys. Soc. (GB), Vol. 77, Pt 4, 845-52 (April, 1961).

A simple source of O^- ions suitable for accelerator applications is described. Negative atomic ion currents of over 2 μA can be directly extracted at 10 keV energy for a low-pressure cold-cathode oxygen discharge source which incorporates an electrostatic constrictor electrode. The input power is only 25 watts and the gas consumption 14 $cm^3\ hr^{-1}$ of oxygen at atmospheric pressure. Mass analysis of the beam has shown the primary components to be O^- and O_2^- ions whilst the main impurity ions are OH^-, Cl^- and NO_2^-. A study was made of the relationship between the negative ion yield and various source operating conditions. The O^- and O_2^- ion yields are shown to be related to the striated structure of the positive column. With a singly striated column the beam is composed mainly of atomic ions. Only when a doubly striated column is formed does the O_2^- yield become large. Ion production processes are discussed in terms of this relationship.

9533 INSTABILITY OF THE POSITIVE COLUMN IN A MAGNETIC FIELD AND THE "ANOMALOUS" DIFFUSION EFFECT. B.B.Kadomtsev and A.V.Nedospasov.
Plasma Phys—Thermonuclear Res. (GB), Vol. 1, No. 4, 230-5 (July, 1960).

The positive column of a gas discharge is shown to become unstable when a sufficiently large longitudinal magnetic field is superimposed. This instability causes oscillations which lead to an increase in the flux of charged particles striking the walls; that is, in agreement with the experimental results, there is an increase in the effective diffusion.

9534 SCALING LAWS FOR ELECTRIC ARCS SUBJECT TO FORCED CONVECTION. C.Sherman and J.M.Yos.
J. appl. Phys. (USA), Vol. 32, No. 4, 744 (April, 1961).

A dimensional expression is given for the voltage of an arc subject to forced convection. Effects included in the analysis (not given) are viscous compressible flow, conductive, convective and radiative heat transfer and ohmic heat dissipation. Effects excluded are self and external magnetic fields, natural convection, non-equilibrium and electrode effects. The expression indicates the existence of a scaling law and an apparatus is described to test the law. Some results are given which indicate the utility of the law. H.Edels

9535 THE BERTELE ARC.
D.Gabor and J.Vithayathil.
Nature (GB), Vol. 189, 821-2 (March 11, 1961).

In the Bertele arc the discharge has the appearance of a glow discharge at the cathode but electrically it exhibits arc properties. The current density at the cathode of a molybdenum thimble appears uniform but is many times higher than the glow value whilst the cathode drop is about 10 V. By high speed photographic techniques, it was revealed that the glow is not uniform but has a ramified appearance and moves rapidly over the surface giving the appearance of a uniform glow. The true current density appears to be ~ 150 amps/cm^2. The spot appears to jump from position to position. From measurements of the power spectrum of the current in the frequency range from a few hundred to 1 Mc/s it is concluded that the photographs indicate red diffuse spots and not concentrated spots moving at speeds higher than those observable with the present techniques. H.Edels

9536 ON THE A.C. RESISTANCE OF ELECTRIC ARCS.
W.Frie.
Z. angew. Phys. (Germany), Vol. 13, No. 2, 99-102 (Feb., 1961).
In German.

An analytic investigation is given of the effective resistance of an arc to a superimposed a.c. current. The Elenbaas—Heller equation is used and with assumptions of a linear electrical conductivity—heat function and an additive disturbance to potential and current, a solution is obtained for the effective a.c. resistance. A plot is given showing the manner in which the relative a.c. to d.c. resistance depends on the frequency of the disturbance and an arc time constant. H.Edels

9537 PHENOMENA ARISING FROM INTENSE CURRENT PULSES IN RESISTIVE CONDUCTORS. M.Fournet.
C. R. Acad. Sci. (France), Vol. 252, No. 14, 2084-6 (April 5, 19
In French.

When a condenser was discharged through a thin metal wir results depended on the pressure in the system. At atmospheri pressure, the wire vaporized, but in a good vacuum it was still intact after 100 pulses. In the first instance the current passed entirely in the wire whereas in the second case a partial vapori tion occurred at the surface in which an arc struck. The resist of the arc was low enough to shunt the wire. It is suggested tha the material is dragged from the surface by the high electrical normal to the surface. The ejected material was detected as a steep wavefront. Similar effects were observed in a vacuum fo graphite. J.W.Stu

CLEANUP OF HOT-CATHODE DISCHARGE TUBES.
See Abstr. 9433

PLASMA

(See also Magnetohydrodynamics)

9538 CLASSICAL AND QUANTUM PLASMAS.
D.Pines.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2
No. 1-4,5-17 (Jan., 1961). [Proceedings of the 1959 Internatio Plasma Physics Institute].

A brief survey is given of the different theoretical approac to the study of the low-density, high-temperature "classical" plasma and of the high-density, low-temperature "quantum" pla The random phase approximation, collective-variables method shown to yield the same result as the collisionless Boltzmann equation combined with the self-consistent field method. Dyna behaviour is studied in the classical plasma, with particular attention to the relationship between individual particle and collective behaviour. The frequency and wave number depend longitudinal dielectric constant of the plasma is used to establi the many similarities in behaviour of quantum and classical pl in the random phase approximation; the validity of the random phase approximation is discussed. Applications of the theory made to the ground state energy of the quantum plasma and to explanation of the characteristic energy losses in solids. The generalizations required to take into account the ionic motion indicated and the results are described.

9539 ON THE MEAN FREE PATH IN PLASMA.
R.W.Larenz.
Naturwissenschaften (Germany), Vol. 48, No. 2, 40 (1961).
In German.

It is claimed that the conventional expression for mean fre path may be incorrect in certain cases. An alternative expres is suggested and it is claimed that it gives a better description the solar corona. H.N.V.Temp

9540 IRREVERSIBLE PROCESSES IN A QUANTUM PLA
R.Balescu.
Physica (Netherlands), Vol. 26, No. 6, 443-4 (June, 1960).

In a previous paper (Abstr. 3776 of 1960) the author derive transport equation for a classical plasma, using a diagram tec The present note gives the result of a completely analogous derivation for a quantum plasma. O.Pe

9541 THE STATISTICAL THERMODYNAMICS OF THE APPROACH TO EQUILIBRIUM OF A PLASM
R.Balescu.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2
No. 1-4, 169-72 (Jan., 1961). [Proceedings of the 1959 Interna Plasma Physics Institute].

After a short presentation of the general theory of irrever processes established by Prigogine and Balescu, its applicatio the problem of long range forces in a plasma is discussed in s detail. A diagram technique permits an unambiguous choice o main contributions to the distribution function. The result is a equation describing the evolution of the distribution function of momenta, which takes rigorously into account the many-body collisions. The latter results from a summation of an infinite of diagrams, the structure of which is very simple. The succe

ms involve more and more particles interacting sumultaneously.
uation has a formal similarity with the usual Fokker—Planck
on, but the Coulomb interaction between two particles is re-
by an effective interaction, which depends on the distribution
he other particles of the medium. At very low temperatures
fective interaction reduces to a screened Coulomb—Debye po-
. The relation of this approach to the previous theories of
as (Fokker—Planck equation, Vlasov equation, random phase
imation) can be discussed very clearly by means of the dia-
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2 THERMODYNAMICS OF IRREVERSIBLE PROCESSES AND THE FORCE EQUATION OF SCHLÜTER.

e.
's. (Germany), Vol. 162, No. 1, 61-8 (1961). In German.
plasma physics one frequently uses phenomenological
ons of motion which express the accelerations of each
nent in terms of a body force, a gradient of partial pressure
ictional force due to the relative motion of other components.
ition one adjoins a heat flow equation involving the tempera-
radient. Relations of this type are attributed to Schlüter
bstr. 5072 of 1950; 5430 of 1951). It is shown here that
ig from the fluid equations of irreversible thermodynamics
ding temperature gradients) an inversion can be performed
throws them into equations of the Schlüter type, with a new
al force arising from thermal diffusion in each mechanical
on. There is thus a reversible link between the friction
cients of plasma physics and the diffusion and thermal
on coefficients, derivable in principle from the Boltzmann
on. Explicit formulae are given for the case of a binary
n. R.O.Davies

43 APPLICATION OF A MODIFIED DEBYE—HÜCKEL THEORY TO FULLY IONIZED GASES.

idder and H.E.DeWitt.
a Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2,
4, 218-23 (Jan., 1961). [Proceedings of the 1959 International
a Physics Institute].
he equations of the Debye—Hückel theory, modified to include
m statistics, are discussed. It is found that the nonlinear
ons used by Cowan and Kirkwood are not unique, and that the
ear theory can be formulated in different ways to give differ-
swers. The linearized equations of these alternative formula-
are discussed, and the correct form of the linearized theory is
ished. From the linear theory, the Helmholtz free energy of a
y degenerate plasma is derived, and from this result, useful
lae in the near-classical limit are obtained for the pressure
ternal energy.

44 ON SCHMIDT'S VIRIAL THEOREM FOR PLASMAS. R.B.R.-Shersby-Harvie.

of Fluids (USA), Vol. 4, No. 3, 389-90 (March, 1961).
king into account some additional factors it has been shown
hmidt's theorem (Abstr. 12612 of 1960) does not exclude
ssibility of a slowly decaying plasmoid. M.Hasan

5 CLASSIFICATION OF DIAGRAMS FOR A PLASMA EQUATION-OF-STATE. H.B.Levine.

a Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2,
4, 206-17 (Jan., 1961). [Proceedings of the 1959 International
a Physics Institute].
ilizing the Montroll—Ward approach to quantum statistics,
lized to many components, an equation of state for a high-
ature low-density plasma is sought. A classification of
ms analogous to that used by Meeron and by Friedman in
al statistical mechanics is proposed. In the resulting expan-
he leading term is the ideal gas contribution plus the lowest-
exchange contribution plus the ring contribution, the latter
enting the effect upon the pressure of collective motions of a
tely ionized plasma. The next term appears to represent a
ution due to modifications of free particle motion due to the
tion of the single particle with the rest of the plasma. The
erm represents the contribution of two-particle states, both of
e energy between all particle pairs, and negative energy
states) between pairs of opposite charge sign. The third term
ntains parts representing modifications of the motion of the
particles due to interaction of the individual particles with
t of the plasma. Higher terms represent, successively, con-
n of three, four, etc. particle states, again including modifi-
of the single-particle motions. The classification automatic-
minates the ultraviolet catastrophe which ordinarily arises in the treatment of Coulomb force bound states in statistical mechanics, since, in effect, it uses a screened Coulomb potential instead of the ordinary potential. In addition, the short range divergence, which occurs in classical theory because of the "fall" of the electron to the nucleus, does not arise, being prevented by the uncertainty principle.

THERMODYNAMIC FUNCTIONS OF A PARTIALLY DEGENERATE, FULLY IONIZED GAS. See Abstr. 9340

9546 FOKKER—PLANCK EQUATION FOR A PLASMA WITH A CONSTANT MAGNETIC FIELD.

N.Rostoker and M.N.Rosenbluth.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 195-205 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

Starting from the Liouville equation, a chain of equations is obtained by integrating out the coordinates of all but one, two-etc. particles. One particle is singled out. All other particles are considered to be initially in thermal equilibrium. For the time evolution of the distribution function of the "singled out" particle an equation is obtained whose asymptotic form is of the usual Fokker—Planck type. It is characterized by a frictional drag force that slows the particle down and a fluctuation tensor that speeds it up and produces diffusion in velocity space. The objective of the calculation is to determine these quantities for a plasma consisting of electrons and protons in a constant external magnetic field. The chain of equations contains two dimensional parameters $\lambda = \omega_c/\omega_p$ and $g = 1/nL_D^3$. A solution for the s-body correlation function is obtained in the form $f_S = f_S^{(0)}(\lambda) + gf_S^{(1)}(\lambda) + \text{etc.}$ $f_S^{(0)}$ and $f_S^{(1)}$ were determined to all orders of λ. The frictional drag consists of a part due to collisions and a part due to plasma wave emission. When $\lambda \ll 1$ the modification of the collisional part due to the magnetic field is negligible. There is a significant change in the properties of plasma waves of wavelength greater than the Larmor radius which modifies the force due to plasma wave emission. When $\lambda \gg 1$ the force due to plasma wave emission disappears. The collisional force is altered to the extent that the maximum impact parameter is sometimes the Larmor radius instead of the Debye length, or something in between. A more interesting modification obtains for the particular case of a slow ion moving perpendicular to the field. It is due to repeated collisions with fast electrons. This collisional force is of a qualitatively different form, but the quantitative modification is not large. In addition to the drag force anti-parallel to the velocity of the particle, there is a collisional force anti-parallel to the Lorentz force. This force arises because the particle and its "shield cloud" are spiralling about field lines. The force on the particle is equal and opposite to the centripetal force acting on the "shield cloud". It is much smaller than the Lorentz force. The main result is that the lowest order in g, the frictional drag and fluctuation tensor are slowly varying functions of λ.

9547 PLASMA DENSITY FLUCTUATIONS IN A MAGNETIC FIELD. E.E.Salpeter.

Phys. Rev. (USA), Vol. 122, No. 6, 1663-74 (June 15, 1961).

Sinusoidal electron charge-density fluctuations with propagation vector $\vec{k}$ are considered for a fully ionized gas in complete thermodynamic equilibrium in a constant magnetic field. α and ϵ are defined as the ratio of the Debye length and of an electron gyroradius, respectively, to the wavelength k^{-1}. A general formula is derived for the frequency spectrum of these fluctuations for arbitrary values of α, ϵ, and of the angle $(\phi - \frac{1}{2}\pi)$ between k and the magnetic field. The dispersion relation implied by this expression has been obtained previously bt Gross (Abstr. 4399 of 1951) and by Bernstein (Abstr. 2432 of 1958), but the method of derivation is different. A very small electron—ion mass ratio m/M is assumed. For large values of ϵ and α most of the intensity occurs at small frequencies: if $\sin\phi \gg (m/M)^{1/2}\epsilon$, the main spectrum is continuous as in the absence of a magnetic field; if $(m/M)^{1/2} \ll \sin\phi \ll (m/M)^{1/2}\epsilon$, it consists of lines with spacing about the ion gyrofrequency; if $\sin\phi \ll (m/M)^{1/2}$, it consists mainly of a line at zero frequency. Weaker spectral lines are obtained which correspond to plasma oscillations; the existence of "frequency gaps" is confirmed for small angles of ϕ, and the intensities of the various components are evaluated. For small ϕ, another spectral line is obtained at a "resonance" frequency intermediate between the electron and ion gyrofrequency.

9548 STABILITY OF AN INHOMOGENEOUS PLASMA IN A MAGNETIC FIELD. B.Lehnert.

Phys. of Fluids (USA), Vol. 4, No. 4, 525-6 (April, 1961).

Extends the treatment of interchange instabilities (Rosenbluth and Longmire, Abstract 8727 of 1957) to the case of a plasma in a plane parallel magnetic field with density gradients. Suggests (i) that the pressure of density gradients greatly reduces the growth rates, (ii) that when the electron —ion drift separation becomes comparable with the wavelength of the perturbation, stabilizing effects, for which a criterion is given, arise. R.S.Pease

9549 SOME VARIATIONAL PRINCIPLES FOR PROBLEMS IN HYDRODYNAMIC AND HYDROMAGNETIC STABILITY.

R.C.DiPrima.

Quart. appl. Math. (USA), Vol. 18, No. 4, 375-85 (Jan., 1961).

The characteristic problems of hydrodynamic and hydromagnetic stability are formulated as variational problems. The methods of solution depend primarily on the expansion of the unknown function and its derivatives in sets of appropriate orthogonal functions. It is shown that these methods can be extended to a non-self adjoint boundary value problem. They are applied to the Taylor problem and the inhibition of convection by a magnetic field. M.Hasan

9550 MAINTENANCE OF EQUILIBRIUM BY INSTABILITIES.

O.Buneman.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 119-34 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

Collective interactions can provide a rapid mechanism for restoring grossly non-Maxwellian distributions to near-Maxwellian in that electrodynamic instabilities will build up to high level within a few plasma periods. Computation of the further development of the instabilities in the non-linear regime shows an approach to statistical randomness.

9551 PLASMA INSTABILITIES ASSOCIATED WITH ANISOTROPIC VELOCITY DISTRIBUTIONS.

E.G.Harris.

Plasma Phys-Accelerators-Thermonuclear Res. (GB), Vol. 2, No. 1-4, 138-45 (Jan., 1961). [Proceedings of 1959 International Plasma Physics Institute].

The general dispersion relation is derived for small amplitude waves in a fully-ionized plasma in an external magnetic field. This derivation is based on the Vlasov equations (Boltzmann equations without collision terms for the electrons and ions plus Maxwell's equations). The dispersion relation involves integrals over the zero-th order velocity distributions. It is found that for sufficiently anisotropic velocity distributions waves exist which have exponentially growing amplitudes. A number of special cases are discussed. It is shown that streams of charged particles passing through a plasma may excite either longitudinal or transverse waves. Other instabilities exist when the distributions are such that the particles have their velocity vectors perpendicular to the magnetic field.

9552 ELECTROSTATIC INSTABILITIES IN OHMICALLY HEATED PLASMAS. J.D.Jukes.

Plasma Phys.—Accelerators—Thermonuclear Res. (GB), Vol. 3, No. 2, 140-5 (April, 1961).

The dispersion equation for electrostatic oscillations in a current-bearing plasma is solved for marginal stability when the electron and ion temperatures are unequal. The result is applied to a plasma ohmically heated by a current which is constant with time. A criterion for instability is compared with a rather similar one for the formation of a runaway beam of electrons. Comparison is made with some experiments in which plasma was ohmically heated (Zeta and stellarator B1) and which developed some instability.

9553 PLASMA DIFFUSION IN SYSTEMS WITH PARTICLE LOSSES. N.J.Phillips.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 965-70 (May, 1961).

In certain experimental fusion devices, plasma is confined by a magnetic field and steadily lost out of the ends of a magnetic bottle. When the scattering rate of particles is high, field diffusion and particle loss can be considered from a macroscopic point of view. The formation of a steady-state sheath into which particles diffuse only to be lost along the lines of force was suggested by Wright and Phillips (1960). The elementary theory is considerably developed here into a state in which the original approximations are evident, though the theory remains essentially phenomenological. It is shown that a steady-state plasma sheath is formed whose thickness depends on the plasma resistivity, sound speed and length. The sheath moves into the plasma with a speed which depends on the same parameters.

9554 PLASMA STUDIES SURVEY OF EXPERIMENTS. I. MAINLY OPTICAL STUDIES. K.G.Emeleus.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 65-8 (Jan., 1961). [Proceedings of the 1959 Internati
Plasma Physics Institute].

This paper concentrates on certain fields which seem wor
further exploration and development. The main topics dealt w
the significance of gas purity and the molecular gas problem;
zation of gross unresolved appearance of a plasma and the nec
for distinguishing between steady and oscillating plasmas, illu
ted by reference to terminal conditions in moving striations;
and turbulence; a possible quantal limitation imposed on time
lution by the Einstein coefficients for allowed and forbidden tr
sitions; formulation of the excitation integral; further example
spectroscopic techniques, including use of interference filters
of potential in sheaths, and a check on the voltage amplitude o
called plasma electron oscillations.

9555 PLASMA STUDIES SURVEY OF EXPERIMENTS. II. MAINLY PROBE STUDIES. K.G.Emeleus.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 69-72 (Jan., 1961). [Proceedings of the 1959 Internat
Plasma Physics Institute].

For Pt I, see preceding abstract. Subjects dealt with inc
the classification of probes; general remarks on metal Lang
probes, and the construction of probes for volume exploration
Langmuir—Druyvesteyn method for determining isotropic dis
butions, its theory, the problem of variable reflection coeffici
and Boyd's development of techniques; exploration of oscillati
plasmas; effects of negative ions on plasma fields and probe
and on the stability of discharges.

9556 OPTICAL PROPERTIES AND EMISSION OF RELATIVISTIC PLASMAS AT CYCLOTRON RES

D.B.Beard.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol
No. 1-4, 94-7 (Jan., 1961). [Proceedings of the 1959 Internati
Plasma Physics Institute].

The cyclotron emission from a hot, completely ionized,
magnetically-confined plasma was estimated by computing th
absorption of an incident plane wave. The harmonics of the
mental cyclotron frequency, which are emitted perpendicula
magnetic field direction, were summed over and also treate
vidually. Because of the Doppler effect and the relativistic
tion in mass the behaviour of the electrons and the electrom
properties of the medium are functions of electron velocity.
ing a Maxwell—Boltzmann distribution in electron velocity, t
zation of the plasma was computed by integrating over electr
velocity. Solution of Maxwell's equations yielded the optical
tants of the plasma and thereby the absorption of an incident
By invoking Kirchhoff's relation, the emission of the plasma
then determined.

9557 THE CONCEPT OF CONDUCTIVITY.

J.E.Drummond, R.A.Gerwin and B.G.Springer.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 98-108 (Jan., 1961). [Proceedings of the 1959 Inter
Plasma Physics Institute].

The concept of conductivity in a hot plasma is reviewed
criticized. In particular, it is shown that even for arbitraril
field strengths, a proportionality constant (tensor) does not
general exist between a frequency component of the field str
and the corresponding component of current density. Rather
sisting upon such a proportionality for a homogeneous plasm
defines a complete set of spatial field configurations (eigenfu
of the conductivity). Each of these eigenfunctions separately
Maxwell's equations. However, for an inhomogeneous plasm
this is not possible since the eigenfunctions of conductivity a
separately solutions of Maxwell's equations. It is possible,
to define an intrinsic high-frequency property of an inhomog
plasma. This does not relate current density to field streng
rather relates the field strength produced by the current den
the field strength causing the current density. Both Maxwel
equations and the particle dynamics are represented in this
property of the inhomogeneous plasma. Equating the produc
causing field strengths again defines eigenfunctions in term
the solution for arbitrary boundary conditions can be found.
amples are given.

EQUILIBRIUM PROPERTIES OF A PARTIALLY IONIZED PLASMA.

G.M.Harris and J.Trulio.

Phys—Accelerators—Thermodynamic Res. (GB), Vol. 2, 224-34 (Jan., 1961). [Proceedings of the 1959 International Physics Institute].

odel for a partially-ionized, partially-dissociated plasma is
ted using known theoretical concepts to describe both bound
electron states, internal molecular degrees of freedom and
interactions. It is applied to a system of particles arising
hydrogen molecule. The Coulomb interaction is treated in
sical Debye approximation. However, a distance of closest
h between ions and electrons depending on the kinetic energy
ectrons is included to avoid the short range divergence of
omb potential. The kinetic energy of the free electoon is
ed from the partition function for a perfect Fermi gas. The
nal and rotational motion is treated in the harmonic oscilla-
rigid rotor approximation with the number of energy levels
for a given electronic state depending on the dissociation
of the state. A volume dependence of the bound electronic
eigenvalues is included by considering the effect of surround-
icles as a confinement of a given particle to a spherical box
ble size. For the counting of the bound electronic states, a
ate is bound until its energy increases to zero due to con-
t. From the partition function for the entire system, the free
s calculated. By a minimization of the free energy of the
the equilibrium composition as a function of temperature
me is obtained. Then not only can thermodynamic quantities
lated, but it is believed that a reasonable approximation to the
balance of molecular, ionic and free electronic states is
over a wide range of V—T space. Consequently, regions
complete ionization and dissociation are important are de-
. In addition, for different regions of V—T space, the rela-
tributions of charged particle interactions, non-classical
r of electrons, internal degrees of freedom and translation
tal energy of the system can be determined.

VERY HIGH FREQUENCY METHODS FOR INVESTIGATION OF PLASMA.

V.E.Golant.

. Fiz. (USSR), Vol. 30, No. 11, 1265-1320 (Nov., 1960).
an.

ensive review of the use of microwaves in plasma investiga-
diagnostics, covering both theory and experimental results.
cle is divided in six main sections: (a) Theory of the
ements of conductivity. The case of a weak v.h.f. electro-
c field is considered separately. Influence of an external
c field. (b) Resonance methods. Determination of the
ters of resonators filled with plasma, under the approxima-
first order perturbation theory. Measurements of the
concentration and of the electron collision frequency.
ion of experimental layouts and experimental results.
smission measurements and propagation in wave guides
th plasma. Experimental procedures and results.
ing of the electron gas by microwaves and its use to study
plasmas. (e) Investigations of plasma with orientated
f microwaves. Optics of the propagation in the case of
eneous plasma and in the presence of a positive gradient
ron density. Information obtainable from transmitted and
d waves. The case of resonant absorption. Experimental
re. (f) On the possibility of using spatial dispersion of
ves to investigate high temperature plasmas. 96 references
ny the text. [English translation in: Soviet Physics—
al Physics (USA), Vol. 5, No. 11, 1197-1248 (May, 1961)].

G.Martelli

VELOCITY AND IMPULSE OF AN ACCELERATED PLASMA.

A.Andrew and J.P.Fitzpatrick.

Fluids (USA), Vol. 4, No. 1, 160-1 (Jan., 1961).

erimental results were presented for the variation of
and velocity of argon plasma produced in a pinch discharge
lerated in vacuum, with the mass of the Argon gas pulse
alf angle, subtended by the ring electrode at the centre of
electrode in the pinch tube. The following expression,
ally obtained with many simplifying assumptions is in
le agreement with experiment:

$$\text{Impulse} = I^2 \ln(r_1/r_2)\Delta t$$

is the current in e.m.u., Δt is the pinch time and r_1 and r_2
adii of the current before and after pinching. M.S.Sodha

9561 MOTION OF A PARTICLE, AND EQUILIBRIUM OF A PLASMA IN CYLINDRICAL GEOMETRY.

P.H.Rebut.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3, No. 1, 22-30 (Jan., 1961). In French.

The exact integration of the collisionless Boltzmann equation can be performed by assuming stationary conditions and cylindrical symmetry. With an additional assumption of isotropy of the velocity distribution, it turns out that the macroscopic motion is that of a solid body. A relation is obtained between the components of the magnetic field in agreement with experimental results.

9562 RUNAWAY AND SUPRATHERMAL PARTICLES.

E.R.Harrison.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 3, 105-15 (March, 1960).

Under certain conditions an electron or ion is accelerated continuously when subject to a force greater than the dynamic friction; as a result it is decoupled from its thermal state of motion and is said to be "runaway". Runaway particles lead to, and form part of, a class of particles which have been referred to elsewhere as "suprathermal". The study of the way in which runaway particles are produced and accelerated is not only of importance in laboratory gas discharges, but also in a wide variety of applications in astrophysics. The subject of runaway electrons and ions is treated, first in a uniform ionized gas in which the particles have Maxwellian velocity distributions and, secondly, in a current conducting plasma. The conditions for decoupling and accelerating particles from their thermal state are discussed and, in particular, it is shown that in the case of a weak electric field ions are unlikely to achieve speeds very much in excess of the drift speed of the electrons, except in restricted regions where runaway electrons are continually forming and escaping. When the ratio of the thermal and magnetic energy densities, given approximately by β, is small, the runaway electron current grows rapidly at the expense of the conducting current. A number of ways are considered in which the runaway current may grow and become predominant. Finally, the generation of suprathermal ions by Fermi interactions is considered, from which it is evident that when β is the order of unity the ion gas is heated and when β is small relatively few ions are accelerated to high energies.

9563 COMMENT ON "REVIEW OF HIGH-TEMPERATURE ROTATING-PLASMA EXPERIMENTS".

J.Slepian.

Rev. mod. Phys. (USA), Vol. 32, No. 4, 1032-3 (Oct., 1960).

Suggests that the equations for the plasma drift and currents used by Wilcox (Abstr. 4156 of 1960) for cylindrical geometry are incorrect. R.S.Pease

9564 REPLY TO COMMENT ON "REVIEW OF HIGH-TEMPERATURE ROTATING-PLASMA EXPERIMENTS".

J.M.Wilcox.

Rev. mod. Phys. (USA), Vol. 32, No. 4, 1033 (Oct., 1960).

Denies the suggestion of Slepian (see previous abstract).

R.S.Pease

9565 NONLINEAR PHENOMENA IN A PLASMA LOCATED IN AN ALTERNATING ELECTROMAGNETIC FIELD.

V.L.Ginzburg and A.V.Gurevich.

Uspekhi fiz. Nauk (USSR), Vol. 70, No. 2, 201-46 (Feb., 1960). In Russian.

Collects a large number of results on the behaviour of fully and partially ionized plasma in an alternating field, the emphasis being on the fact that, in certain circumstances, nonlinear effects appear at easily attainable amplitudes. As a result of the nonlinearity, the plasma can often behave in two different ways in a given field, the steady-state that is actually attained depending on the history. 68 refs. [English translation in: Soviet Physics—Uspekhi (USA), Vol. 3(70), No. 1, 115-46 (July-Aug., 1960)]. H.N.V.Temperley

9566 NON-LINEAR EFFECTS IN ELECTRON PLASMAS.

P.A.Sturrock.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 158-63 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

The effect of non-linear terms in the dynamical equations governing wave propagation in plasmas may be analysed by a perturbation procedure which is acceptable for amplitudes which are not too large. The Hamiltonian describing the complete system is separated into two parts: the quadratic part which yields the linearized equations and the non-linear part. The quadratic part may be eliminated by a normal-mode analysis, the "normal modes" comprising travelling waves. The non-linear part then results in interaction between these waves. Two theorems concerning wave interaction are proved. The first relates energy-transfer between a group of interacting waves to the frequency of these waves. These "action-transfer relations" lead to the Manley—Rowe relations for steady-state or quasi-steady-state configurations. The second theorem relates the frequency-displacements of a group of interacting waves to the energies of these waves. The properties of electron plasmas undergoing longitudinal oscillations are re-examined in the light of the preceding theorems. Interaction terms may be classed as "coherent" and "incoherent"; the former do not result in energy transfer but only frequency displacement which may be characterized by a dispersion relation. The second group leads to transfer of energy between waves and hence to spectral decay. The interaction between longitudinal (electrostatic) and transverse (electromagnetic) waves in plasmas is considered and it is shown that in a uniform plasma in the absence of magnetic fields, the dominant interaction couples two longitudinal waves with one transverse wave. Hence one would anticipate that the dominant non-linear mechanism for radiation from excited plasmas leads to emission at twice the plasma frequency.

9567 A QUASI-LINEAR MODEL OF PLASMA SHOCK STRUCTURE IN A LONGITUDINAL MAGNETIC FIELD.

E.N.Parker.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 146-53 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

It is pointed out that interpenetration of two plasma streams along a uniform magnetic field is prevented by the hose instability. Thus the shock thickness resulting from supersonic streaming of a tenuous plasma along a uniform magnetic field may be very much less than the collision length. It is suggested that an actual stationary shock front under these conditions is formed by the hose interaction between the incoming supersonic stream and a precursor, consisting of ions evaporating forward from the non-linear disordering which results when the hose instability reaches large amplitude. Treating the growth of the hose instability with the WKB approximation applied to the linearized equations, it is shown that the scale of the shock front is characterized by the ion and electron Larmor radii, and that the density in the precursor relaxes to a small but non-vanishing value, proportional to the reciprocal of the square of the Mach number, infinitely far ahead of the shock.

9568 TRAVELLING WAVE INTERACTION IN PLASMAS.

G.D.Boyd and R.W.Gould.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 88-9 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

Interaction between a slow space charge wave which travels along a cylindrical plasma column and an electron beam which passes down the axis of the column is demonstrated experimentally. A spatially growing wave exists when the velocity of the beam is approximately equal to the velocity of the unperturbed wave.

STARK BROADENING OF HYDROGENIC ION LINES IN A PLASMA. See Abstr. 8809

X-RAY CONTINUA AND LINE SPECTRA FROM HIGHLY STRIPPED ATOMS IN A MAGNETICALLY COMPRESSED PLASMA. See Abstr. 8820

9569 ON THE THEORY OF BREMSSTRAHLUNG IN HYDROGEN PLASMAS INCLUDING THE GAUNT-FACTOR.

H.Schirmer.

Z. angew. Phys. (Germany), Vol. 13, No. 2, 56-9 (Feb., 1961). In German.

Quantum mechanical treatments of plasma bremsstrahlung involve the Gaunt-factor which in exact form is difficult to deal with. Based on the exact theory of Sommerfeld, the influence of the Gaunt-factor on emission, absorption and radiation density of hydrogen plasma bremsstrahlung is studied numerically over a wide range of frequencies. Also, the relative influence of bremsstrahlung and recombination radiation is examined as a function of temperature.

P.M.Parker

9570 ON THE INFLUENCE OF THE CROSS-SECTIONAL DISTRIBUTION OF ELECTRON DENSITY ON THE PROPAGATION OF ELECTRIC WAVES IN A LONGITUDINALL MAGNETIZED PLASMA IN A METALLIC HOLLOW CONDUCT

W.O.Schumann.

Z. angew. Phys. (Germany), Vol. 12, No. 10, 442-6 (Oct., 1960).
In German.

The propagation of electric waves along the axis of a magn
plasma is discussed. A simple model of a plasma without colli
damping in a conducting envelope and with a linear radial electr
density distribution is assumed. Such a model produces results
which the propagation constant is no longer infinite and the phas
velocity no longer approaches zero. The effect of the dielectric
layer between the plasma and wall is also discussed. H.

9571 EXPERIMENTAL STUDY OF A PLASMA COLUMN A MICROWAVE CAVITY.

S.J.Buchsbaum, E.I.Gordon and S.C.Brown.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 164-8 (Jan., 1961). [Proceedings of the 1959 Internati
Plasma Physics Institute].

Experiments designed to study the production of a steady-
plasma column by microwave cavity means are described. At
plasma densities electrons are heated by cyclotron resonance
crossed microwave electric and static magnetic fields. Pheno
associated with large energies which the electrons possess ne
cyclotron resonance are discussed. Large plasma densities a
achieved by resonating the plasma column by suitably varying
static magnetic field, the microwave frequency and the input p
In this manner, densities of the order of 10^{12} cm^{-3} are obtaine
neutral gas pressure in the micron range.

9572 EXPERIMENTS ON INTERACTION OF PLASMAS MICROWAVES. J.G.Linhart.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 109-11 (Jan., 1961). [Proceedings of the 1959 Internat
Plasma Physics Institute].

A short discussion is presented of some experimental wo
the field of plasma physics in progress at CERN.

9573 CYCLOTRON RADIATION FROM A HOT PLASM

W.E.Drummond.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 90-3 (Jan., 1961). [Proceedings of the 1959 Internati
Plasma Physics Institute].

In their Geneva paper, Trubnikov and Kudryavtsev calcul
the cyclotron radiation from a hot plasma. In doing this, the
approximation was made that the individual particles radiated
though they were in a vacuum. An investigation of this approx
mation was made by calculating the absorption length directly
the Boltzmann equation and was found to be correct whenever
$\omega_p^2/\Omega^2 \ll n^2$ where n is the harmonic number of the radiation
question, ω_p is the plasma frequency, and Ω is the cyclotron f
cy. For a contained plasma, the left-hand side of this inequali
of the order of magnitude of one and thus the inequality is wel
fied for the dominant radiation from a plasma at high tempera
The physical reason for this inequality can be investigated by
solving the test-charge problem to find the transverse respon
current of the plasma to the motion of an electron. The resul
that the transverse organizing length in the plasma is c/ω_p, a
thus one may picture an electron in its Larmor orbit as being
surrounded by a co-moving current cloud of radius c/ω_p. Cla
electrodynamics then leads to the above inequality.

9574 EMISSION OF SUB-MILLIMETRE ELECTROMAG RADIATION FROM HOT PLASMA IN ZETA.

G.N.Harding, M.F.Kimmitt, J.H.Ludlow, P.Porteous, A.C.Pri
V.Roberts.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 1069-75 (May, 1961).

The first results are reported of experiments using a tec
new to plasma research, namely spectroscopy in the far infra
region (wavelength 0.1—1.6 mm). The shapes of the spectra
obtained from Zeta are consistent with the observed radiation
entirely due to free—free transitions (bremsstrahlung) and be
characteristic of black-body emission at the longer wavelengt
The measured absolute values of the surface brightness of the
discharge are in agreement (subject to reasonable assumptio
the predictions of quantum theory.

)PAGATION OF CENTIMETRIC WAVES IN WAVEGUIDES
WITH PLASMA FROM THE POSITIVE COLUMN OF A
RGE. See Abstr. 9587

5 SOME INVESTIGATIONS ON THE PHYSICS OF A
HEATED PLASMA AND ITS CONTAINMENT.
ontovich.
Phys–Accelerators–Thermonuclear Res. (GB), Vol. 1,
, 3-7 (Oct., 1959).
ecture given at the Atomic Energy Research Establishment,
, England on April 28, 1959 by Academician Leontovich on a
of theoretical and experimental investigations in plasma
, performed at the Atomic Energy Institute of the USSR
y of Sciences.

6 APPLICATION OF BOHM'S CRITERION FOR THE
FORMATION OF A SHEATH. L.S.Hall.
f Fluids (USA), Vol. 4, No. 3, 388-9 (March,1961).
hm's analysis [The characteristics of electrical discharges
etic fields, edited by Guthrie and Wakerling, New York;
; London: McGraw-Hill Book Company (1949), Cha. 3] of
tric fields at a plasma–solid interface is approximate. The
n deduced therefrom is more a condition for the applica-
f the analysis than a stability requirement. The assumption
tabilities and anomalous diffusion necessarily occur when
erion is violated is therefore unjustified. R.S.Pease

7 A PLASMA COLUMN WITH HEAT LOSSES AT
ELECTRODES. S.I.Braginsky and V.D.Shafronov.
a physics", Vol. II (see Abstr. 5439 of 1961) p. 1-27.
lculates the temperatures, temperature gradients, energy
nd column radius for a simple pinch assumed stable, with
losses due solely to conduction to the electrodes and
trahlung radiation. R.S.Pease

8 PLASMA COLUMN IN AN EXTERNAL LONGITUDINAL
MAGNETIC FIELD. S.I.Braginsky and V.D.Shafronov.
a Physics", Vol. II (see Abstr. 5439 of 1961) p. 39-126.
extensive theoretical discussion of the important para-
in the joule and adiabatic heating of a plasma column in a
f geometries extending from the simple pinch geometry to
e of pure axial fields. Stationary state solutions are given,
time-dependent solutions and similarity relations taking
ount the diffusion of magnetic field into the column (skin
Includes the effects of thermal conductivity, differing ion
tron temperatures, radiation and electrode cooling; and
e solution of the equations for the "paramagnetic" effect,
h the axial field is enhanced by the azimuthal field due to
py of electrical conductivity. R.S.Pease

ON THE PASSAGE OF HIGH CURRENT THROUGH A
PLASMA IN THE PRESENCE OF A LONGITUDINAL
TIC FIELD. L.A.Artsimovich
physics", Vol. II (see Abstr. 5439 of 1960) p. 127-34
culations of the collapse phase of a stabilized pinch with skin
Shows that inertial terms are important during an initial
$/M/H_0$, where M is the mass per unit length of the plasma,
initial longitudinal field. Shows that there are inertial
ons. R.S.Pease

AN ANALYSIS OF THE EQUATION OF PLASMA
COLUMN CONTRACTION IN THE PRESENCE OF AN
AL MAGNETIC FIELD. L.A.Artsimovich.
physics", Vol. II (see Abstr. 5439 of 1961) p. 153-64.
culates in more detail the inertial oscillations referred to in
eding abstract, including expressions for the flux change
circular loop enclosing the plasma column — a quantity of
ional importance. R.S.Pease

ON THE STABILITY OF A PLASMA COLUMN IN THE
PRESENCE OF A LONGITUDINAL MAGNETIC FIELD
ONDUCTING CASING. V.D.Shafronov.
physics", Vol. II (see Abstr. 5439 of 1961) p. 197-215.
ulates the dispersion relation for the normal modes of
n of the stabilized pinch configuration with infinite conduct-
zero skin thickness, and deduces the conditions for stability
of ratio of the column radius to the tube radius, and the
he internal to external longitudinal magnetic field.
R.S.Pease

9582 ON THE MECHANISM OF THE OBSERVED NEUTRON RADIATION. S.M.Osovets.
"Plasma physics", Vol. II (see Abstr. 5439 of 1961) p. 239-43.

Single calculations on the neutron emission observed in Russian pinched discharges suggests, on the basis of energy requirements, that accelerated deuterons must have energies between 20 and 1000 keV, and the number must be about $3 \times 10^{-3}\%$ of the total number. R.S.Pease

9583 INVESTIGATION OF PULSE DISCHARGES IN GASES WITH A CURRENT OF 500 kA.
A.M.Andrianov, O.A.Bazilevskaia and V.G.Prokhorov.
"Plasma physics", Vol. II (see Abstr. 5439 of 1961) p. 274-308.

Magnetic and electric field distributions were measured for cylindrical discharges in deuterium, hydrogen, helium, argon and xenon. Oscillograms are given of voltage, current and neutron pulses. Calculation of the effective tube inductance and average discharge compression rate are given. Curves are given of the variation with time of the radial distribution of current and magnetic field. The longitudinal electric field was calculated from measured valves of the magnetic field, and curves are given for the radial distribution of the electric field and its variation with time. H.Edels

9584 CONFINING A PLASMA IN STEADY ELECTRIC AND MAGNETIC FIELDS. K.A.George.
Nature (GB), Vol. 190, 334 (April 22, 1961).

Experiments were performed on an apparatus similar to a PIG ion source in which the ions were trapped in an electric potential well in a magnetic field. Deuterium at a few microns Hg was used so that the D–D reaction neutrons could be used to study the plasma. Discharge voltages of 10-20 kV were used and the field was 1700 gauss. Neutrons were observed which came mainly from the discharge. More neutrons were observed at low energies than predicted by the Gamow curve indicating confinement of the ions. J.W.Sturgess

9585 THE SHOCK MODEL OF THE DYNAMIC PINCH. J.A.Reynolds and J.M.P.Quinn.
Plasma Phys–Accelerators–Thermonuclear Res. (GB), Vol. 3, No. 2, 135-9 (April, 1961).

Various models of the dynamic z-pinch are discussed and photographic evidence from experiments using hydrogen and deuterium discharges in a straight tube is given in support of a shock model which allows for energy spent in ionization and dissociation. Effectively, the ionization and dissociation reduce γ from 5/3 to the region of 1.2. The temperature of the shocked gas is calculated from the measured shock velocity, and a curve of temperature against initial gas pressure is given. This temperature varies between 0.5 and 25 eV for pressures of 10 000 μ to 100 μ which corresponds to 10 to 30% of the directed radial energy of the ions. Thus the pinch, during the implosion phase, consists of a rapidly imploding skin of low energy plasma.

9586 ON THE MECHANISM OF LINEAR PINCH EFFECT. H.Zwicker and F.D.Erbslöh.
Naturwissenschaften (Germany), Vol. 47, No. 19, 440 (1960).
In German.

The behaviour of a pinched cylindrical discharge in helium is investigated by cinematographic and electric methods, within the range of pressure between 0.1 and 10 torr. At a pressure of about 1 torr some sharply defined bright bands appear at the edge of the discharge tube. These bright zones occur when the time derivative of the phase current is negative. The maximum contraction occurs when there is no discharge current. The bright zones are explained as additional current sheets within the plasma cylinder. A mechanism similar to the skin effect is discussed. M.Hasan

9587 ON THE CONFINEMENT OF CHARGED PARTICLES IN A MAGNETIC FIELD. B.Lehnert.
Plasma Phys–Accelerators–Thermonuclear Res. (GB), Vol. 1, No. 1-2, 40-8 (Oct., 1959).

A self-sustained thermonuclear fusion reaction requires a high degree of particle confinement. A ring-shaped solid conductor placed in the interior of the reaction volume produces a strong poloidal magnetic field which traps particles completely, at least at low gas densities. The leads which supply current to the conductor can be arranged in a way such as to prevent particle losses out of the confinement volume. Modifications and improvements of the magnetic field configuration by the addition of auxiliary coils are discussed. Injection of ions into the confinement volume is discussed briefly as well as a number of other possible heating mechanisms. A short consideration of the stability problem is also given.

9588

EQUILIBRIUM CONFIGURATIONS OF A TOROIDAL PLASMA.

E.W.Laing, S.J.Roberts and R.T.P.Whipple.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 1-2, 49-54 (Oct., 1959).

Equilibrium configurations of a toroidal plasma were obtained, characterized by parameters for the gas pressure and the toroidal component of the magnetic field and by the aspect ratio of the torus. These configurations are symmetrical about the axis of the torus and fall naturally into two classes, corresponding to cases where the toroidal component of the magnetic field either is in the same direction over a cross-section of the torus or changes direction in the centre of the cross-section.

9589

NEUTRON EMISSION FROM LINEAR PINCHES IN DEUTERIUM AT HIGH RATES OF CURRENT RISE.

H.A.B.Bodin, R.A.Fitch and N.J.Peacock.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 4, 206-14 (July, 1960).

This paper describes the neutron emission observed during an investigation of the characteristics of fast linear Z-pinches using a low-inductance condenser bank. The neutron production is compared with the results obtained elsewhere and is shown to be different in several respects from that obtained with low-power banks, but is quite similar to that reported in more recent, high-power experiments. It is shown that much of the yield is non-thermonuclear, and a number of existing theories for the production of neutrons by acceleration processes in a plasma are discussed. A process of neutron production in fast linear pinches is suggested, which qualitatively accounts for many recently reported results: the proposed mechanism becomes the well-known Colgate process in discharges where m = 0 instabilities lead to narrow necks in the plasma. Reasons are given to account for the absence of appreciable thermonuclear yields which might be expected from theoretical considerations.

9590

THE INJECTION OF PLASMOIDS INTO A MAGNETIC TRAP WITH A FIELD WHICH INCREASES TOWARDS THE PERIPHERY.

I.M.Podgornyi and V.N.Sumarokov.
Plasma Phys— Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 4, 236-9 (July, 1960).

The feasibility of filling up a magnetic trap with plasma was investigated by injecting accelerated plasmoids into a trap formed by a magnetic field which increases towards the periphery. It is shown that in such a system the lifetime of the plasma is several tens of microseconds under the conditions of these experiments.

9591

AN EXPERIMENTAL TEST OF THE BEHAVIOUR OF CHARGED PARTICLES IN AN ADIABATIC TRAP.

S.N.Rodionov.
Atomnaya Energiya (USSR), Vol. 6, 623 (1959). In Russian.
English translation in: Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 4, 247-52 (July, 1960).

The motion of tritium β-particles in an adiabatic trap is considered. It is shown that under some conditions the β-particles may be reflected from the strong-field region (the magnetic mirror) more than 10^7 times. The lifetime of the particle has been studied as a function of the gas pressure and of the configuration and uniformity of the magnetic field.

9592

CONFINEMENT OF AN ELECTRON BEAM BY OSCILLATING ELECTROMAGNETIC FIELDS.

E.S.Weibel and G.L.Clark.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 112-16 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

It has been shown theoretically that a charged particle can be bound in stable orbits about the axis of a circular wave guide by the fields of the TE_{01} mode at cut-off (Weibel, 1959). This result was verified experimentally. The apparatus consists of a 20-cm long section of a circular wave guide, properly terminated, into which is fed radio-frequency power from a magnetron at f = 9·29 kMc/s in 2 μsec pulses. A uniform TE_{01} field is excited over the entire 20-cm length of the guide. An electron beam which is injected axially at one end of the cavity diverges strongly due to coulomb repulsion if no radio-frequency power is applied. During the radio-frequeny pulse, however, the beam is confined to the axis and 90% of the current is collected by an axial probe of 0·3 cm
diameter which is located at the other end of the guide. Betwe
pulses when no radio frequency is applied, no measurable curr
reaches the probe. In its trajectory from the gun to the probe
electron spends about 170 radio-frequency periods in the focus
field.

9593

INSTABILITY OF INDUCED [THETA-] PINCH.

I.F.Kvartskhava, K.N.Kervalidze and Yu.S.Gvaladz
Zh. tekh. Fiz. (USSR), Vol. 30, No. 11, 1321-28 (Nov., 1960).
In Russian.

The behaviour of a theta-pinch is investigated by means of
ultrafast photographic method, allowing up to 2×10^8 pictures
second to be taken. (For a preliminary description of this wor
see Abstr. 15039 of 1960 and Abstr. 2974 of 1961). The present
measurements were carried out with hydrogen, helium, nitroge
air, argon and krypton at various pressures, in discharge cham
of various shapes. The pictures were taken along the axis of t
discharge chamber, and some results are displayed in two plat
reproducing 24 series of photographs, accompanied by two tabl
specifying the relevant parameters. A detailed qualitative dis
ion is given. Correlations are found between the various stage
the pinch and the onset and development of the instabilities. It
suggested that the inhomogeneous concentration of plasma in t
pinch, which accompanies the "eruptive" instabilities, might b
to the presence of runaway electrons. [English translation in:
Soviet Physics - Technical Physics (USA), Vol. 5, No. 11, 125
(May, 1961)]. G.M

A LIQUID CONDUCTOR MODEL OF THE HOLLOW PINC

See Abstr. 9678

9594

THE EFFECT OF ELECTRODES IN A LINEAR PIN DISCHARGE.

M.G.Haines.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 643-56 (March, 1961).

A linear pinched discharge in fully ionized hydrogen or
deuterium is examined theoretically under an idealized stead
condition, when there is a pressure and an energy balance an
instabilities. Under this condition, the Joule heating caused b
axial current is balanced by bremsstrahlung radiation losses
axial heat conduction and diffusion to the electrodes. A parti
analytical solution is found assuming that the transport coeffic
have the usual power dependencies on temperature throughou
plasma. It is shown that all the energy not radiated is carrie
anode, the cathode even having a negative total heat flux at its
due to thermal effects of diffusion by the current-carrying el
The maximum temperature in the discharge is shown to vary
with the voltage across the tube and only insensitively to othe
meters. Further relations are derived involving the dimensi
the discharge, the current and the maximum temperature. T
temperature, the line density and the electric field are plotte
showing their variation along the axis. The relative importan
heat conduction and radiation losses is seen to depend only on
total axial current which is flowing. A typical example of a di
shows that temperatures of 10^6 to 10^{7}° K are quite feasible in
presence of heat losses to the electrodes.

9595

HEATING OF A PLASMA BY ACOUSTIC WAVES.

T.Dodo.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1292-5 (July, 1960).

Ac acoustic wave is generated by imposing as oscillating
magnetic field to a cylindrical plasma in a static magnetic fie
When the suitable frequency of oscillating field is chosen, an
acoustic wave is excited at an intermediate state between adi
and isothermal states. In this situation acoustic energies are
transformed into thermal energies through the irreversible f
heat due to stress relaxation. In this method, the efficiency
heating is very high. The calculation shows that this method
be suitable to heat a plasma of moderate temperature (10^5 ~
and of high density (10^{14} ~ 10^{16} particles/cm^3).

9596

THE OHMIC HEATING OF POSITIVE IONS IN AN IMPURE PLASMA.

A.A.Ware and J.A.Wesson.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 801-6 (March, 1961).

It is shown that in a plasma which is heated by an electri
current the direct heating of the positive ions can be increase
markedly by the presence of a small concentration of impurit
With favourable impurity concentrations, this heating is suffi
to explain the observed ion temperature in Zeta and Sceptre.

7 MAGNETIC ROTARY POLARIZATION IN PLASMAS-
APPLICATION TO THE MEASUREMENT OF THE
TRON DENSITY. T.Consoli and M.Dagai.
a Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3,
115-28 (April, 1961). In French.
ne rotation of a linearly-polarized wave, propagating parallel
direction of a static magnetic field, is studied under certain
ctive conditions and for the following range of parameters:

$$10^8 \text{ e/m}^3 < \text{electronic density} < 10^{24} \text{ e/m}^3$$
$$10^{-4} \text{ gauss} < \text{magnetic field} < 10^7 \text{ gauss}$$
$$10^7 \text{ c/s} < \text{exploring frequency} < 10^{15} \text{ c/s.}$$

etical results are given as a family of curves. Two experi-
l set-ups are described; one measuring the right-hand and
nd indices, the other their difference (i.e. the rotation of
ctric field vector of the emerging wave). Some experimental
s are given.

8 A STEPWISE INCREASE IN THE ELECTRON CURRENT
TO A PROBE PLACED IN A DISCHARGE IN A
ETIC FIELD. A.V.Zharinov.
aya Energiya (USSR), Vol. 7, 215 (1959). In Russian.
h translation in: Plasma Phys—Accelerators—Thermonuclear
GB), Vol. 1, No. 4, 267-70 (July, 1960).
reliminary results from a study of the effect of a magnetic
n electron diffusion in a plasma are described. A stepwise
se in the ratio of the electron current to the ion current to a
has been found for a certain critical magnetic field strength.
ding to the preliminary results, this critical magnetic field is
tional to the gas pressure. These facts seem to indicate that
are two qualitatively different mechanisms of the transverse
nent of electrons, one of these being diffusion by collisions.

99 THE DIFFUSION OF ELECTRONS IN A MAGNETIC
FIELD. A.V.Zharinov.
aya Energiya (USSR), Vol. 7, 220 (1959). In Russian. Eng-
anslation in: Plasma Phys—Accelerators—Thermonuclear
GB), Vol. 1, No. 4, 271-4 (July, 1960).
xperimental data concerning the anomalously high mobility
trons across a magnetic field are discussed. It is shown
e concentration distribution of the secondary plasma of a
thode discharge is almost independent of the transverse
on coefficient of the electrons, and so cannot be used to
ate the mechanism of diffusion. The electron diffusion
ient is estimated from the density of the electron current to
ode; the result confirms that the transverse mobility is
lously high.

00 NON-ADIABATIC MAGNETIC TRAPS.
E.W.Laing and A.E.Robson.
a Phys — Accelerators — Thermonuclear Res. (GB), Vol. 3,
146-55 (April, 1961).
novel method of injection into a mirror machine, reported
elnikov et al. (see abstr. 10954-5 of 1960) is analysed in
by numerical and perturbation solutions of the equations of
of a single particle. The principle of the method is to
particles through one of the mirrors, along the lines of force.
agnetic field in the centre of the machine has a small,
ly periodic radial component which, for certain initial condi-
causes a resonant interchange of energy from the longitudinal
ransverse component of the particle's velocity. This results
ection of the particles by the end mirror, and by suitable
nent of the mirrors the particles may be contained inside
chine for an appreciable number of transits. The possibility
easing the accumulation of particles by combining this method
tion with molecular-ion dissociation is also discussed.

1 SELF-CONSISTENT FIELD THEORY OF PLASMA
BETATRONS. G.Schmidt.
Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3,
156-61 (April, 1961).
quasi-stationary, self-constistent field theory is developed
space-charge neutralized plasma betatron. It is found that
ilibrium orbit shrinks in the first phase of the acceleration
, and this sets a limit to the number of particles which can
lerated. Exceeding this limit the beam collapses. During
eleration process, the beam passes through a betatron
dominated and a self-pinching phase, and finally enters the
stic regime. Limits where these phases set in, as well as
m behaviour in different phases is given.

9602 PLASMA INVESTIGATION IN THE DEVICE "ALPHA". V.V.Afrosimov, V.A.Glukhikh, V.E.Golant, A.N.Zaidel, E.G.Komar, B.P.Konstantinov, G.M.Malȳshev, I.F.Malȳshev, N.A.Monoszon, A.M.Stolov and N.V.Fedorenko.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1381-93 (Dec., 1960). In Russian.

General description of a new thermonuclear device, where powerful current pulses can be obtained in a toroidal chamber (torus diameter 3.2 m, section diameter 1 m) with a stabilising longitudinal magnetic field. Discharges in hydrogen were studied at a pressure of $\sim 2 \times 10^{-4}$ mm Hg and with magnetic fields from 140 to 720 Oe. The duration of the pulses was 2-3 msec, the energy stored in the bank of condensers being 1.5×10^6 Joule. Results are given on the measurements of electrical and magnetic characteristics of the discharge, on radio frequency and spectroscopic investigation of the plasma, on probe measurements and on tentative evaluation of neutral runaway atoms. The formation of the discharge and its development do not correspond to the usual picture describing a self-pinching discharge in a quasi-stationary state. This was deduced by the absence of a prolonged core, the presence of strong azimuthal currents, increase of the magnetic currents through the internal chamber up to values exceeding the initial magnetic current through the thick walled chamber, asymmetry of the discharge, presence of oscillations, irregular collective motions, and unequal distribution of the ions. [English translation in Soviet Physics - Technical Physics (USA), Vol. 5, No. 12, 1311-21 (June, 1961)]. G.Martelli

9603 CONSTRUCTIONAL DATA AND BASIC PARAMETERS OF THE "ALPHA" APPARATUS. V.A.Glukhikh, E.G.Komar, B.A.Larionov, I.F.Malȳshev, N.A.Monoszon, A.M.Stolov and N.S.Strel'tsov.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1394-1403 (Dec., 1960). In Russian.

For abstract, see Abstr. 5477 of 1961. [English translation in: Soviet Physics—Technical Physics (USA), Vol. 5, No. 12, 1322-30 (June, 1961)].

9604 MEASUREMENT OF THE FLOW OF ENERGY RADIATED BY THE PLASMA IN THE APPARATUS "ALPHA". V.A.Burtsev, A.M.Stolov and V.V.Shakhov.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1415-21 (Dec., 1960). In Russian.

For abstract, see Abstr. 5478 of 1961. [English translation in: Soviet Physics—Technical Physics (USA), Vol. 5, No. 12, 1340-5 (June, 1961)].

9605 INVESTIGATIONS OF SPECTRA IN THE "ALPHA" APPARATUS. I. THE NATURE OF SPECTRA AND THE TEMPERATURE. A.N.Zaidel', G.M.Malȳshev, E.Ya.Shreider, A.B.Berezin, B.A.Belyaeva, B.I.Gladushtak, V.V.Skidan and L.V.Sokolova.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1422-32 (Dec., 1960). In Russian.

For abstract, see Abstr. 5479 of 1961. [English translation in: Soviet Physics—Technical Physics (USA), Vol. 5, No. 12, 1346-55 (June, 1961)].

9606 INVESTIGATIONS OF SPECTRA IN THE "ALPHA" APPARATUS. II. THE DIRECTED MOTION OF IONS. A.N.Zaidel', G.M.Malȳshev, E.I.Moskalev, E.A.Ptitsȳna, L.V.Sokolova and G.I.Chashchina.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1433-6 (Dec., 1960). In Russian.

For abstract, see Abstr. 5480 of 1961. [English translation in: Soviet Physics—Technical Physics (USA), Vol. 5, No. 12, 1356-9 (June, 1961)].

9607 INVESTIGATIONS OF SPECTRA IN THE "ALPHA" APPARATUS. III. TIME CHARACTERISTICS OF THE PLASMA EMISSION. A.N.Zaidel', G.M.Malȳshev, A.B.Berezin and G.T.Razdobarin.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1437-46 (Dec., 1960). In Russian.

For abstract, see Abstr. 5481 of 1961. [English translation in: Soviet Physics—Technical Physics (USA), Vol. 5, No. 12, 1360-9 (June, 1961)].

9608 A METHOD FOR INVESTIGATING THE FLUX OF ATOMS EMITTED BY A PLASMA.

V.V.Afrosimov, I.P.Gladkovskii, Yu.S.Gordeev, I.F.Kalinkevich and N.V.Fedorenko.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1456-68 (Dec., 1960).
In Russian.

A device to measure the flux of neutral atoms with energies from 300 eV up to some tens of keV is described in some detail. The neutral atoms are first ionized, further accelerated and then counted as individual particles, thus allowing an absolute measurement of the flux. The energy spectrum of the particles can also be obtained, together with some information about their masses. The measurements can be carried out on pulsed sources as, for instance, strong pulsed discharges in ionized gases. The minimum detectable flux is about 10^{10} cm^{-2}sec^{-1} for isotropically distributed hydrogen atoms with energies of $\sim$ 300 eV, but the sensitivity of the method increases with increasing energy of the atoms. [English translation in: Soviet Physics - Technical - Physics (USA), Vol. 5, No. 12, 1378-88 (June, 1961)]. G.Martelli

9609 INVESTIGATION OF THE FLUX OF NEUTRAL ATOMIC PARTICLES EMITTED BY THE PLASMA IN THE DEVICE "ALPHA".

V.V.Afrosimov, I.P.Gladkovskii, Yu.S.Gordeev, I.F.Kalinkevich, M.P.Petrov and N.V.Fedorenko.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1469-84 (Dec., 1960).
In Russian.

Using the method of the preceding abstract, an investigation was carried out on the flux of atoms with energies from 300 eV to 10 KeV emitted by the plasma. The energy spectra and their time dependence during the discharge were studied. The mass analysis shows that these beams consist mainly of atomic hydrogen. The concentration of atoms with energy from 300 eV to 10 KeV was determined in the chamber of "Alpha", together with the energy losses induced by the escape of these atoms from the plasma. The relation between the energy spectrum of these runaway atoms and that of the ions in the plasma is investigated in detail. [English translation in: Soviet Physics - Technical Physics (USA), Vol. 5, No. 12, 1389-1402 (June, 1961)]. G.Martelli

9610 ON THE ENERGY DISTRIBUTION OF FAST NEUTRAL ATOMS LEAVING A PLASMA.

O.V.Konstantinov and V.I.Perel'.
Zh. tekh. Fiz. (USSR), Vol. 30, No. 12, 1485-8 (Dec., 1960).
In Russian.

Theoretical work to explain the observed energy spectra of neutral atoms from "Alpha". It is assumed that the presence of high energy neutral atoms is due to recombination of charged ions on the neighbourhood of the walls, and the calculation is a generalization of the method already developed, for the case of a plane wall, by Zubarev and Klimov. [Fizika Plasmy i problema upravlyaemȳkh termoyadernȳkh reaktsii. Vol. 1, p. 138, Moscow; Leningrad: Akademiya Nauk SSSR (1958)]. [English translation in: Soviet Physics-Technical Physics (USA) Vol. 5, No. 12, 1403-6 (June, 1961)]. G.Martelli

9611 MAGNETIC FIELD DIFFUSION IN ZETA.

D.J.Lees and M.G.Rusbridge.
Phys. of Fluids (USA), Vol. 4, No. 5, 653-4 (May, 1961).

The diffusion of the initial skin current was measured as a function of initial gas pressure, gas type and capacitor voltage. The diffusion time increases with the mass density of the gas and decreases with increasing electron temperature and with increasing capacitor voltage. The diffusion is therefore thought not to be determined by simple resistive diffusion due to binary electron—ion collisions. R.S.Pease

9612 EXPERIMENTS WITH PLASMA RINGS.

H.Alfvén, L.Lindberg and P.Mitlid.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 3, 116-20 (March, 1960).

The construction of a coaxial plasma gun is described. At its output end the gun is provided with a radial magnetic field, which is trapped by the plasma. The plasma which is shot out from the gun is studied by photographic and magnetic methods. It is demonstrated that the gun produces magnetized plasma rings with the same basic structure as the rings obtained in toroidal pinch experiments. When the plasma rings are formed, the magnetic field lines from the gun break, a result which is of interest from a theoretical point of view.

9613 CRITICAL CURRENT FOR BURN-OUT IN AN OGR TYPE DEVICE.

A.Simon
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1
No. 4, 215-29 (July, 1960).

A complete algebraic analysis has been obtained for the
variation of the steady-state ion density n+ with injected curre
an OGRA-type fusion device (i.e. a device based on trapping of
by break-up of energetic molecular ions on collision with eithe
background gas or trapped ions). The most general variation o
n+ with I is shown to be an S-curve with at most three roots of
for a given input I. A physical interpretation of these three ro
given. In addition algebraic expressions are obtained for the t
currents at which the bends in the S-curve occur. It will be
necessary to attain the larger current in order to build up a hig
density plasma when the density is being increased from below
On the other hand, once the high density has been achieved, it m
be maintained by steady injection of a current larger than the l
value. Parameters corresponding roughly to the specifications
OGRA are used to obtain some numerical results. In the final
appendix, the previously published formulae for burn-out in DC
are extended to include effects of neutral backstreaming from t
input beam and "ion-pumping".

9614 THE LIFETIME OF FAST IONS IN OGRA.

G.F.Bogdanov, D.A.Panov and N.N.Semashko.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3
No. 2, 106-14 (April, 1961).

The lifetime of injected H_2^+ ions and trapped H^+ ions in OC
was measured. It is found that the mean free path of molecule
ions is about 1.5 km for a magnetic field configuration which gi
the optimum velocity of azimuthal drift. The maximum lifetim
atomic ions of energy 100 keV is 9.3 ± 0.9 msec at a pressure
1×10^{-7} mm mercury. The lifetime of atomic ions of energy
is 3.2 msec at a pressure 2.5×10^{-8} mm mercury. The maxi
density of atomic ions after injection of 20 mA of H_2^+ ions
energy 200 keV is about 1.5×10^7 cm^{-3}. The dependence of t
lifetime on the ion energy and residual gas pressure shows tha
OGRA there are no mechanisms of loss of captured ions, other t
charge exchange with the residual gas, up to characteristic tim
of the order of 10 msec.

9615 RESONANCE PROCESSES IN MAGNETIC TRAPS.

B.V.Chirikov.
Atomnaya Energiya (USSR), Vol. 6, 630 (1959). In Russian.
English translation in: Plasma Phys—Accelerators—Thermon
Res. (GB), Vol. 1, No. 4, 253-60 (July, 1960).

Consideration is given to resonances between the Larmor
rotation of charged particles and their slow oscillations along
lines of force. Under certain conditions these resonances can
result in a complete exchange of energy among the degrees of
dom of the particle, so that the particle escapes from the trap
influence of resonances on adiabatic processes associated wit
time variation of the magnetic field is also examined.

9616 PLASMA DIFFUSION IN STELLARATORS.

T.Coor.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 81-3 (Jan., 1961). [Proceedings of the 1959 Internati
Plasma Physics Institute].

During ohmic heating of plasma confined in a stellarator
observed that the plasma moves across the magnetic confinin
at a much higher average velocity than is predicted by classic
considerations. An attempt has been made to compare the ob
velocity with the calculated drifts that should result from the
sured randomly varying electric fields and density gradients
in the plasma. It is found that the random quantities, as mea
double probes, are of sufficient intensity to give order-of-ma
agreement between observed and calculated velocities. A new
thesis is put forward to explain the origin of these high-ampl
fluctuations, a hypothesis which might be applicable to gas di
generally. It is assumed that the non-Maxwellian electron di
bution resulting from the applied electric field excites large
tude, coherent plasma oscillations near the plasma frequency
large amplitude oscillations act as the "pump" in the non-line
process known as parametric amplification. Thermal fluctua
normally present with small amplitudes in quiescent plasmas
amplified over a wide band of frequencies, both above and bel
pump frequency, by the resulting parametric amplifier action
plasma. This results in high-amplitude noise which might pr
enhanced diffusion and rapid thermalization effects.

7 ION CYCLOTRON HEATING OF A PLASMA.
T.H.Stix.
Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2,
, 84-7 (Jan., 1961). [Proceedings of the 1959 International
Physics Institute].
eriments with ion cyclotron heating of a deuterium plasma
d in the B-65 stellarator are reported. Single-particle type
ur is evidenced by the production of neutrons, ascribed to
ns accelerated in the low density region beneath the induction
at the outside of the plasma, at a value B_0 of confining mag-
eld corresponding to single particle resonance. Ion cyclotron
haviour is indicated by the emission of light from deuterium
m several times ionized impurity elements, the light intensity
at a value of the magnetic field about 10% larger than B_0.
m absorption of the ion cyclotron wave energy is calculated
r in a cylindrical shell where the ion density is about 10^{13} cm^{-3}
litative support is given experimentally by the emitted light
Complete ionization of the deuterium plasma may be obtained
.f. induction heating alone, with the highest electron tempera-
ccurring for magnetic fields corresponding to ion cyclotron
esonance. Operation of the B-65 machine as a magnetic mirror
ment device with ion cyclotron heating led to neutron pro-
, induction coil loading, emission of deuterium and impurity
milar to stellarator operation.

3 PLASMA CYCLOTRON RADIATION AND FUSION REACTORS. J.D.Jukes.
Phys.—Accelerators—Thermonuclear Res. (GB), Vol. 3,
-7 (Jan., 1961).
e theory of cyclotron radiation from high-temperature plasma
d within a magnetic field is applied to the estimation of the
n loss from plasma confined in fusion reactors. It is shown
etallic reflector placed around the plasma should limit the
ness of this loss. In the case of a mirror machine, compari-
nade with the mirror loss and the electrical power dissipated
oils producing the magnetic field. Ratios of power lost are
s functions of β/η (plasma to magnetic pressure ratio/
ion coefficient of the reflector) and βBR (B is the field
h, R the mean radius) which are also compared with the
yield. For the stabilized pinch and stellarator, cyclotron
compared with nuclear yield. With β not less than 0.1 it is
hat cyclotron loss can be unimportant in all three types of
actor. For the D—D mirror machine the minimum necessary
BR would be about 2×10^8 gauss cm, whilst for the pinch or
tor the minimum necessary current or BR, based only on
n loss, is 18×10^6 amperes or 3.5×10^6 gauss cm
ively.

) MEASUREMENTS OF THE PROTON ENERGIES FROM SCEPTRE III.
nes, K.M.Young and A.C.L.Barnard.
Phys.—Accelerators—Thermonuclear Res. (GB), Vol. 3,
-13 (Jan., 1961).
asurements of the energies of the protons emitted from a
m discharge in Sceptre III using nuclear plate cameras,
ormation on the motions of the fusing deuterons in the
ge. Experimental results on proton energies from four
f exposures at different stabilizing magnetic fields using
s observing the discharge at nominal angles of 45°, 90° and
given, together with the results of exposures of the cameras
-energetic protons from the A.E.I. electrostatic generator
heir instrumental linewidths. These results show that the
the proton spectra observed at 45° and 135° to the discharge
due to fusions of deuterons whose centre of mass velocity
e axis is 5×10^7 cm/sec. The broadening of the proton
observed at 90° is due to a centre-of-mass motion of
g deuterons in the radial plane of about 2×10^7 cm/sec.
indicated that azimuthal motions occur in this plane. All
otions are largely independent of the stabilizing magnetic
is also apparent from the plates that the fusion region of
arge is displaced from the centre of the torus tube at the
ion section.

SYNCHROTRON RADIATION FROM RUNAWAY ELECTRONS IN THE STELLARATOR.
, C.D.Lustig and S.Sanders.
Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3,
-21 (Jan., 1961).
microwave radiation from low-density plasmas following
ating discharges in the B-3 stellarator has been studied.
rved spectrum was found to be consistent with a calculated
spectrum of synchrotron radiation from runaway electrons accelerated by the applied electric field. The deviation of the radiation frequency from the electron cyclotron frequency is attributed to Doppler shift caused by motion of the emitting electrons along the magnetic field. The maximum observed frequency deviation corresponded, within 10%, to the maximum electron velocity which was kinematically possible, over an electron energy range extending from 25 keV to almost 1 MeV.

Plasma Oscillations

9621 INSTABILITY WAVES IN MAGNETICALLY CONFINED PLASMAS. A.A.Ware.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3, No. 2, 93-7 (April, 1961).

In most of the treatments of hydromagnetic stability, the perfect conductivity approximation has been made which ignores the Hall e.m.f. For small amplitude perturbations with frequency $\omega/2\pi$, the solutions for ω^2 are always real, and for an unstable discharge ($\omega^2 < 0$) there are no oscillations or wave motion. Experimentally, however, wave motion is observed. It is pointed out in this paper that if the Hall e.m.f. is retained, wave motion is then obtained theoretically which is in good agreement with experiment. The full set of hydromagnetic equations is not solved; instead a physical picture of the wave motion is obtained by considering the property of "freezing in" of magnetic lines of force in the plasma. When the Hall e.m.f. is retained the magnetic field is trapped to the mean motion of the electrons. The approximate wave velocity obtained is the component of electron drift velocity perpendicular to the instability.

9622 SOME EXPERIMENTS ON PLASMA ALFVÉN WAVES. S.Nagao and T.Sato.
J. Phys. Soc. Japan, Vol. 15, No. 4, 735 (April, 1960).

Alfvén wave velocities and amplitudes in air pre-ionized by a discharge are presented as functions of the axial magnetic field, gas pressure, and pre-ionization current. Ball-and-ring electrodes were used at each end of a glass discharge tube 60 cm long by 30 cm diameter. Though the wave frequency is significant compared to the ion cyclotron frequency the results show agreement with theory, particularly at low gas pressure and high magnetic field.

D.M.Gilbey

9623 THE DISPERSION RELATION OF PLASMA OSCILLATIONS. II—III.
M.Hasikuni.
J. Sci. Hiroshima Univ. A (Japan), Vol. 24, No. 1, 23-9 (July); No. 2, 233-7 (Oct., 1960).

For Pt I see Abstr. 6647 of 1954. A theory of dispersion of plasma oscillations is developed by simultaneous treatment of the linearized Boltzmann equation (neglecting collisions) for ions and electrons and the Poisson equation. The dispersion relations are obtained in terms of the ratio of phase speed to the thermal speed, and various limiting cases are discussed. It is shown that ion oscillations cannot occur unless the ratio of ion to electron temperature is less than 0.23. The theory shows that in the low frequency limit plasma waves behave as acoustic waves. From available experimental evidence the author suggests that the positive and negative striations in a gas discharge are ionic and electronic oscillations respectively, with velocities predicted by the theory (in the low frequency limit).

M.S.Sodha

9624 COLLECTIVE MOTIONS IN A PLASMA DUE TO MAGNETIC INTERACTION. G.Kalman.
Nuovo Cimento (Italy), Vol. 20, No. 1, 198-200 (April 1, 1961).

Preliminary report of a calculation of the transverse modes of oscillation of a plasma with no applied magnetic field. The Bohm—Pines method is used and Coulomb interactions are neglected.

O.Penrose

9625 OSCILLATIONS OF A PLASMA IN A STATIC MAGNETIC FIELD. N.Anderson.
Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 971-9 (May, 1961).

The propagation of waves through an infinite homogeneous plasma permeated by a static magnetic field is considered. The Boltzmann equation is linearized by the usual perturbation method and the distribution function obtained in the form of an integral. From the expression for the distribution function the current density is calculated, which on insertion into Maxwell's equations gives the dielectric tensor relating the components of the displacement to those of the electric field. Explicit expressions are given for the components of the dielectric tensor in the particular case when the mean Larmor radius of the particles is considerably less than the wavelength of the oscillation and the wave velocity considerably greater than the mean thermal velocity of the particles. Under these conditions, the change in the wave velocity due to thermal effects is calculated by means of an eigenvalue method which uses the wave velocity in the absence of thermal effects and the dielectric tensor.

9626 NON-LINEAR THEORY OF SLOW PLASMA WAVES
Ya.B.Fainberg.
Atomnaya Energiya (USSR), Vol. 6, 447 (1959). In Russian. English translation in: Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 3, 153-7 (1960).

The propagation of electromagnetic waves in a narrow plasma waveguide is examined in a nonlinear approximation. The dependence of the phase velocity on the amplitude is derived, and consideration is given to the problem of frequency multiplication. The amplitude of the second harmonic is calculated. Owing to nonlinear effects a new possibility arises of varying the phase velocity of the wave by means of a variation of the amplitude and of ensuring radial and phase stability in accelerators and also of a certain modification of the methods of amplifying and generating microradio waves.

9627 LONGITUDINAL PLASMA OSCILLATIONS.
J.D.Jackson.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 4, 171-89 (July, 1960).

The present paper is a coherent account of various aspects of longitudinal oscillations in one and two component plasmas. A discussion is offered of dispersion equations, conditions necessary for the growth or decay of oscillations, the physical mechanisms of growing or damping, and the possibility of arbitrary steady-state solutions. The physical situation is described in terms of Poisson's equation and the Boltzmann equation, while the mathematical description is in terms of solutions of an initial-value problem in the small amplitude (linearized) approximation. Some general results are derived for an arbitrary unperturbed velocity distribution of electrons and ions. From these expressions the customary results for a stationary plasma in thermal equilibrium can readily be obtained. For simplicity, one-dimensional motion of a simple one-component plasma is treated in detail; appropriate generalizations for two or more component plasmas (electrons and ions) are indicated. Collisions between particles and non-linear effects are not considered, nor are the effects of external electric or magnetic fields.

9628 LONGITUDINAL PLASMA OSCILLATIONS IN AN ELECTRIC FIELD.
B.D.Fried, M.Gell-Mann, J.D.Jackson and H.W.Wyld.
Plasma Phys —Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 4, 190-8 (July, 1960).

The properties of longitudinal plasma oscillations in an external electric field are investigated. In a completely linear approximation, it is found that the direct-current electric field introduces essentially no new effects. A quasi-linear approximation is also considered, in which couplings between different plasma modes are neglected while the space-averaged distribution functions are assumed to be approximately independent of time. In this case, a Maxwellian distribution function is found to be always unstable against the growth of very long wavelength oscillations.

9629 THE TOMONAGA METHOD AND SOME OF ITS APPLICATIONS. D.ter Haar.
Plasma Phys--Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 25-6 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

A brief account is given of Tomonaga's method of introducing collective coordinates (Abstr. 6368-9 of 1956). This is applied to a derivation of the dispersion relations for plasma oscillations. The result is different from the one obtained by Pines and Bohm and possible reasons for this difference are given. Finally Jepsen's method is outlined for deriving the hydrodynamic equations of motion.

9630 COLLECTIVE OSCILLATIONS OF A SYSTEM OF INTERACTING FERMIONS. A.E.Glassgold.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 51-6 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

Collective oscillations for an infinite system of fermions are discussed for the general case where the force between two particles depends on the internal variables as well as on their relative
separation and momentum. Two theories are reviewed, one b
Watson, Heckrotte and Glassgold, which is based on Sawada's
treatment of the electron gas, and the otherm a semiclassical
ment by Landau.

9631 PLASMA OSCILLATIONS.
K.G.Emeleus and D.W.Mahaffey.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 117-18 (Jan., 1961). [Proceedings of the 1959 Intern
Plasma Physics Institute].

Surveys experiments on the kMc/s oscillations, believed
longitudinal, generated when electron beams traverse a plasn
touching on the evidence they provide for the mechanism of c
of directed motion and its bearing on astrophysical and heavy
problems and the probable importance of electron concentrati
gradients evidenced from experiments by Wehner and by the a

9632 ON THE RADIATION FROM CO-OPERATIVE PHE
MENA IN PLASMAS. C.Oberman.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-4, 155-7 (Jan., 1961). [Proceedings of the 1959 Internat
Plasma Physics Institute].

Of prime importance in plasma investigations is the know
of the interaction of a bounded plasma with external magnetic
The present paper concerns itself with the general properties
the radiation due to plasma oscillations of bounded plasmas of
geometries situated in a strong magnetic field. The special p
lems of transmission, reflection and scattering due to plasma
and columns are also discussed as well as the problems of th
response of the plasma to near fields in the vicinity of its sur
The effects of thermal spread in the particle velocity distribu
are included in the presentation.

9633 REGULAR OSCILLATIONS IN A TOROIDAL DISCHARGE.
M.G.Rusbridge, H.W.Jones, D.J.Lees, P.A.H.Saunders and E.A
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 2, 98-105 (April, 1961).

Regular oscillations were detected under a limited range
conditions in a 12 in. bore torus. The electric and magnetic
associated with these were investigated and indicate a helical
notch of reduced density travelling on the pinched current ch
with a uniform velocity. A possible explanation of the pheno
is given. The oscillation is considered to be growing as a so
wave in a partially-ionized medium. The mode is cited as an
example of a pinched discharge with poor confinement.

ELECTRON EMISSION
ELECTRON BEAMS

9634 ON THE TEMPERATURE DEPENDENCE OF EX
ELECTRON EMISSION. H.Birgfellner and H.M
Acta phys. Austriaca, Vol. 14, No. 1, 56-62 (1961). In Germ

More exact control of the warming rate of exo-electron
emission "glow" curves shows that peaks of emission occur
identical temperatures of different metal surfaces. It is co
that the metastable electron states involved are the same in
and not characteristic of the metals. G.F.

9635 ELECTRON EMISSION CURRENT FROM OXIDE
COATED CATHODE SUBJECT TO HIGH ELEC
FIELD. C.Shibata.
J. Phys. Soc. Japan, Vol. 15, No. 6, 1124 (June, 1960).

Experimental results are presented which indicate that
mionic emission currents i from oxide-coated cathodes sub
to electric fields E greater than about 10^3 V cm^{-1} do not ob
Schottky relation log i $\propto \sqrt{E}$. C.

9636 DEPARTURES FROM THE PHOTOELECTRIC
PROPORTIONALITY LAW IN GAS-FILLED
PHOTOCELLS IN THE LOW CURRENT AND ANOMALOUS
REGIONS. W.Kluge and A.Schulz.
Z. angew. Phys. (Germany), Vol. 13, No. 2, 64-72 (Feb., 1
In German.

Presents experimental curves for the dependence of t

ırrent on the primary photo-electron current and on the
e voltage for tubes containing 0.1 torr of Argon and
athodes of (Ag)-KH,K-K or of (Ag)-K_2O,K-K, which are
gainst the discharge. The gas amplification factor is
ed in terms of Rogowski's development of Townsend's
ne mechanism. The effect of a stabilizing load resistance
considered.
F.F.Roberts

ON THE CLASSIFICATION OF ELECTRON STREAMS.

J.D.Lawson.

Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1,
31-5 (Oct., 1959).

relationships between different types of electron streams
veniently be studied in terms of three dimensionless
eristic parameters. These are f, the ratio of positive to
charge in the stream, v, the product of the number of
s per unit length in the stream and the classical electron
e^2/mc^2), and ϵ defined as $(1-\beta^2)^{-1/2}-1$, where βc is the
ocity. With the aid of these parameters a number of typical
in which f is zero (electron beams in vacuum tubes and
ators) or unity (neutralized electron beams, Budker's self-
ted beam, pinched gas discharge plasmas) are studied, and
ships between them are illustrated on the log ϵ —log v plane.

3 CRITICAL POINTS IN THE THEORY OF ELECTRON BEAM DEVICES.

J.R.Pierce.

Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2,
73-80 (Jan., 1961). [Proceedings of the 1959 International
Physics Institute].

ile working on the theory of electron beam devices such as
ng-wave tubes and klystrons, many problems were met with,
which occur in mathematical formulation of other plasma
s. Among these is the matter of multi-velocity flow. Here
e two mathematically equivalent approaches. In one, the
flow is divided into streams according to the initial unper-
elocities of the electrons; the variables are the densities
ocities in the various streams. In the other, velocity is re-
as a co-ordinate of phase space and the variable is the
in phase space. These approaches give different apprecia-
the phenomena involved and lead to different mathematical
ies, but are the same in content. Each demonstrates the
stence of wave-type solutions in many infinite velocity distri-
Only a few specialized solutions of multi-velocity problems
s different velocity co-ordinates can be used, so different
o-ordinates can be used. The Eulerian approach is common
s to no difficulties if boundary conditions are met at fluctua-
ndaries. In the case of thin beams, it is sometimes useful
isplacements from the mean position of the particles as
s. Some workers have made mistakes by mixing co-ordinate
. In dealing with power flow in electron beams, one can
eplace the actual physical system with a linear system and
xpression for power in this system, or try to deal with the
ow in the true non-linear system. The former alternative is
mpler. Kinetic power, as well as electromagnetic power, is
it in considering the orthogonality of wave-type components.
g an actual physical problem, one can either assemble
wave-type components so as to satisfy the boundary con-
or solve the problem by transform or perhaps by other means.
nts of the solution must be regarded as merely a part of the
of an actual problem, but they can sometimes be given a
le physical interpretation. Thus, one finds waves with
and negative powers. When two unattenuated waves having
f the same sign are coupled together, one observes beats.
unattenuated waves having powers of opposite signs are
ogether, one observes growing and decaying waves. Growing
n also be produced when a moving discontinuity couples two
ted waves together (parametric amplification).

INSTABILITIES AND GROWING WAVES IN ELECTRON BEAM DEVICES.

J.R.Pierce.

Phys-Accelerators-Thermonuclear Res. (GB), Vol. 2
135-7 (Jan., 1961). [Proceedings of the 1959 International
Physics Institute].

e forms of electron flow are unequivocally unstable in the
at perturbations grow with time. Excessive currents be-
ids or through tubes in the presence or absence of neutra-
sitive charge provide examples. Such instabilities are
iated with wave components which grow with distance for
uencies. Thin beams in magnetic fields also show instabi-
r the action of space charge forces. Tubes sometimes
ain in the absence of any wave component which exhibits
spatial growth for real frequencies. There is a large class of amplifiers whose operation can be explained in terms of spatially growing waves. The physical mechanism can be variously described as instability in a moving co-ordinate system, as a result of a negative dielectric constant at the frequency of operation which causes electrons to attract rather than to repel one another, as a result of coupling between positive energy and negative energy waves, and in other terms. In the easitron, an inductive wall results in growing waves. In the resistive wall amplifier, the abstraction of power from negative energy waves results in growth. In the travelling-wave tube amplifier, a positive power circuit wave is coupled to a negative power space charge wave. In the double stream amplifier, the negative power space charge wave of the faster stream is coupled to the positive power space charge wave of the slower stream. In velocity jump and rippled stream amplifiers, periodic discontinuities couple the positive power and negative power waves of the same stream. In wave-type parametric amplifiers, moving periodic discontinuities couple two unattenuated waves. The explanations listed are convenient in connection with the particular device, rather than unique.

CONFINEMENT OF AN ELECTRON BEAM BY OSCILLATING ELECTROMAGNETIC FIELDS.

See Abstr. 9592

9640 ON A SOLUTION OF THE PARAXIAL RAY EQUATION IN AN EXIALLY SYMMETRICAL ELECTROSTATIC FIELD.

N.Shibata.

J. Phys. Soc. Japan, Vol. 15, No. 1, 200 (Jan., 1960).

An analytical solution is obtained for the paraxial ray equation of electron motion in an exially symmetrical electrostatic field in which the axial potential is of quadratic form. Trajectories are traced by dividing a field into short regions over which quadratic variation is a sufficiently close approximation to the measured axial potential, and calculating the path segment by segment. The method has been applied to an investigation of the electron optical properties of an X-ray tube similar to that designed by Ehrenberg and Spear, for which Spear (Abstr. 443 of 1951) had originally used a solution of the paraxial ray equation obtained by numerical methods.
V.E.Cosslett.

AN ELECTRON OPTICAL METHOD FOR THE MEASUREMENT OF MAGNETIZATION OF FERROMAGNETIC SAMPLES.

See Abstr. 9666

9641 FIRST ORDER OPTICS OF THIN MAGNETIC CYLINDRICAL LENSES.

G.Bacquet, P.Gautier and A.Santouil.

C.R. Acad. Sci. (France), Vol. 252, No. 4, 522-4 (Jan. 23, 1961).
In French.

A simple rectangular model of the field is used for a theoretical study of the essential optical properties of thin magnetic cylindrical lenses. Experimental investigations of such lenses, made with an electron optical bench, have confirmed the theoretical deductions.
V.E.Cosslett

9642 FIELD CHROMATIC ABERRATIONS IN AN ELECTRON MICROSCOPE.

V.N.Vertsner and Yu.V.Vorob'ev.

Optika i Spektrosk. (USSR), Vol. 10, No. 1, 120-6 (Jan., 1961).
In Russian.

Recent work on magnetic lenses is used in a calculation of field chromatic aberrations in electron microscopes. These aberrations were studied experimentally in an electron microscope ÉM-3 with diffraction grating replicas as objects. [English translation in: Optics and Spektrosc, (USA) Vol. 10, No. 1, 58-61 (Jan., 1961)].
A.Tybulewicz

ION EMISSION . ION BEAMS

9643 BEHAVIOUR OF IONS IN MASS SPECTROMETERS UNDER PULSED REPELLER VOLTAGE CONDITIONS.

A.Galli, A. Giardini-Guidoni and G.G.Volpi.

Nuovo Cimento (Italy), Vol. 18, No. 6, 1277-9 (Dec. 16, 1960).

A square wave of variable frequency (2 kc/s-2 Mc/s) was applied to the repeller of an ion source, superimposed on a negative d.c. potential, in an attempt to investigate the way the discharge builds up in the source. Because of the averaging effect of the detector used, the data were insensitive to the model chosen.
J.W.Sturgess

9644 HIGH CURRENT POSITIVE HYDROGEN ION SOURCE WITH MASS ANALYSIS.

P.H.Rose, R.P.Bastide and A.B.Wittkower.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 581-5 (May, 1961).

A high current positive ion source with an extraction electrode, focusing system and mass analysis is described. The results of experiments on the apparatus for different geometries are presented. The difficulties involved in extracting and containing ion beams under space-charge forces are explored and a practical method which reduces the space-charge effects is described. It is shown that when space-charge densities of ~30 mA/in^2. are reached the optimum Einzel lens geometry is a function of beam current and beam diameter at the position of measurement.

9645 FORMATION OF HELIUM ION BEAMS BY THE INJECTION OF A NEUTRAL HELIUM BEAM INTO A TANDEM ACCELERATOR.

P.H.Rose, A.B.Wittkower, R.P.Bastide and A.J.Gale.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 568-71 (May, 1961).

A neutral helium beam, obtained by charge-exchange of fast He$^+$ in helium gas, was injected into a tandem accelerator. The energetic neutral beam drifted to the central terminal where electron stripping occurred in oxygen gas, and the resulting He$^+$ and He^{2+} ions were accelerated from the terminal to ground. These ions were then separated by a 90° analysing magnet. Approximately 1.6 μA He$^+$ and 1.0 μA He^{2+} were obtained at an injection energy of 450 keV independent of the tandem terminal voltage. Beam intensities were measured before and after the charge-exchange reactions.

9646 ON THE USE OF GEIGER COUNTERS FOR HIGH SENSITIVITY AND RAPID RESPONSE IN MASS SPECTROSCOPIC INVESTIGATIONS. F.Kirchner.

Z. angew. Phys. (Germany), Vol. 13, No. 2, 53-6 (Feb., 1961).
In German.

A new method for using a Geiger counter in conjunction with a mass spectroscope to cover a wide range of atomic mass is described. For this purpose a continuously evacuated chamber was inserted between the spectroscope and the counter. The size of the exit slit of the spectroscope was 0.05 × 2 mm^2. The entrance slit of the counter should in this case be 0.001 × 2 mm^2. However, it was found possible to work with an entrance slit of 0.02 mm. width by using electrical ion lenses to form a reduced image of the exit slit of the spectroscope on the entrance slit of the counter. With this device the spectrum of a wide mass range could be shown on a fluorescent screen within a few seconds. R.Schnurmann

9647 SPUTTERING OF COPPER SINGLE CRYSTALS BOMBARDED WITH A$^+$, Kr$^+$ and Ne$^+$ IONS WITH ENERGIES RANGING FROM 300–2000 eV.

M.Koedam and A.Hoogendoorn.
Physica (Netherlands), Vol. 26, No. 5, 351-2 (May, 1960).

Atom ejection patterns are studied. From a [100] surface, it is found that the ratio of atoms ejected in a [100] direction normal to the surface to those ejected in the four [100] directions increases with ion energy and lower atomic weight of the ions. From a [111] surface 6-fold symetrical patterns are obtained with the ejection directions corresponding to the [110] and [114] directions, with the [114] directions disappearing at higher energies but not at higher target temperature (500°C). From a [110] surface the [110] direction normal to the surface becomes predominant at higher energies. G.K.Wehner

PARTICLE ACCELERATORS

9648 PRODUCTION OF HIGH DENSITY PROTON CURRENTS FOR COLLIDING BEAM ACCELERATORS.

J.W.Burren, D.Morgan and W.Walkinshaw.
Plasma Phys —Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 1-2, 8-18 (Oct., 1959).

A head-on collision of two 15 GeV protons produces an energy in the centre of mass equivalent to about 500 GeV with the target at rest. To achieve significant production of secondaries, intense beams of particles are required, and this is obtained by "stacking" successive pulses of particles at high energy. Limitations imposed by the accelerating system are examined and upper limits are given to the densities that can be obtained under different assumptions.

HIGH-VACUUM PUMPS AND UNITS FOR ACCELERATO
See Abstr. 9426

9649 THE INJECTOR FOR THE HARWELL PROTON LINEAR ACCELERATOR.

L.C.W.Hobbis, E.R.Harrison and H.C.Whitby.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 3, 130-4 (March, 1960).

The injector is a d.c. accelerator delivering a pulsed pro beam of 15 mA at an energy of 515 keV. The installation is d and details are given of its most important features.

9650 CHARGE TRANSPORT WITH ARTIFICIAL FIBRE VAN DE GRAAFF GENERATORS. E.Bailitis.

Z. angew Phys. (Germany), Vol. 13, No. 1, 36-41 (Jan., 1961).
In German.

Briefly reviews the advantages of using a continuous synt cord in a Van de Graaff generator instead of the usual rubberi belt. It is shown that a theoretical charge density of 4 × 10^{-9} coulomb/cm^2 can be attained in air at atmospheric pressure. has been verified using an experimental 500 kV machine in wh 80 "Perlon" cords 1 mm in diameter are arranged side-by-si giving an output of 0.25 × 10^{-3} A for a linear cord speed of 50 m/sec. A.E.I. Research Labo

FORMATION OF HELIUM ION BEAMS BY THE INJECTI A NEUTRAL HELIUM BEAM INTO A TANDEM ACCELERAT
See Abstr. 9645

9651 AN EXPERIMENTAL AND THEORETICAL INVES TION OF THE MAGNETIC FIELD PRODUCED B RIDGED POLE-PIECES. P.F.Smith.

Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol.
No. 1-2, 55-65 (Oct., 1959).

An experimental investigation is described of the magnet field distribution arising from straight parallel ridges of rec lar cross-section on the poles of a magnet. The "field flutte and "mean gap" are defined and summarized graphically for extensive range of ridge configurations, and for mean fields 20 kG. By comparison with the fields produced by spiral rid configurations it is shown that the results are directly applic the design of the spiral ridge pole-pieces required by certa of particle accelerator. The experimental investigation is s mented by a number of theoretical calculations which enable results to be extrapolated outside the range covered by the ments. Brief discussions are included of the harmonic cont of the field waveforms and of the use of ridge cross-section than rectangular.

9652 ON THE STUDY AND DESIGN OF CYCLIC ELEC ACCELERATORS AT THE TOMSK POLYTECH INSTITUTE. A.A.Vorobiev and V.A.Moskalev.

Atomnaya Energiya (USSR), Vol. 4, 229 (1958). In Russian.
translation in: Plasma Phys.–Accelerators—Thermonuclear
(GB), Vol. 1, No. 1-2, 89-95 (Oct., 1959).

A short account is given of the results of studies on cyc electronic accelerators performed since 1946 at the Tomsk technic Institute. The basic design data and special constru features of several betatrons are described. Various metho are discussed for extracting the electrons from the betatron erating chamber. A betatron producing 25 MeV electrons is described in more detail. The use of annular accelerating e connected to an external two wire resonant transmission lin 30 MeV synchrotron is also reported.

9653 THE FRASCATI STORAGE RING. C.Bernardini, G.F.Corazza, G.Ghigo and B.Tou

Nuovo Cimento (Italy), Vol. 18, No. 6, 1293-5 (Dec. 16, 1960

Gives brief details of the storage ring proposed for col beam experiments with electrons and positrons. It is hoped study of pion—pion interactions and the measurement of the of the π^0 meson will be possible. J.W.

9654 A CYCLOTRON WITH A RADIALLY TRAVELL MAGNETIC WAVE. E.G.Komar.

Atomnaya Energiya (USSR), Vol. 7, 57 (1959). In Russian.
translation in: Plasma Phys—Accelerators—Thermonuclea
(GB), Vol. 1, No. 4, 261-6 (July, 1960).

Possible designs for a cyclotron with a radially travell magnetic field wave are considered and relations between th meters are deduced. One or more radially travelling wave produced in the magnet gap by using separate ring windings an a.c. source. Two possible systems are proposed. In the the travelling wave is responsible for accelerating the part

ond, a travelling field is superimposed on the normal fixed
id the particles are accelerated in the resulting total field.
on of stability (1 > n > 0) can be obtained and this must move
ds at the radial velocity of the particles. Stability is possible
bsolute field strength increases sharply from the inside to
side of the acceleration zone. In principle, the system would
he production of particles with energies as high as desired.
of the cyclic nature of the action, the mean beam intensity
vell be better than that from a synchrocyclotron because of
focusing. Some approximate calculations are presented for
rators of this type designed to produce various energies. It
n that for a given energy the weight and size can be sub-
lly less than for other types of accelerator.

5 ON THE POSSIBILITY OF ACCELERATING POLARIZED PROTONS IN A CYCLOTRON.

ndyansky, Yu.A.Zavenyagin, N.D.Federov and V.A.Khrabrov.
aya Energiya (USSR), Vol. 6, 306 (1959). In Russian. English
tion in: Plasma Phys—Accelerators—Thermonuclear Res.
Vol. 1, No. 3, 149-52 (March, 1960).
e probability of spin re-orientation is estimated for polarized
accelerated in a cyclotron in which the field falls off with
sing radius and varies azimuthally. Beam extraction is also
ered. The depolarization probabilities are shown to be both

E BLOCKING INDUCTOR IN THE MAGNET SUPPLY T OF THE ITALIAN 1000 MeV SYNCHROTRON.

str. 8290

6 THE SUPPRESSION OF BETATRON OSCILLATIONS IN STRONG-FOCUSING ELECTRON SYNCHROTRONS.

lomenskii and A.N.Lebedev.
aya Energiya (USSR), Vol. 5, 554 (1958). In Russian. English
tion in: Plasma Phys—Accelerators—Thermonuclear Res.
ol. 1, No. 3, 139-42 (March, 1960).
rious methods of producing simultaneous radiation damping
hrotron and betatron oscillations in a strong focusing
rator are examined and formulae for calculating the damping
nent are given. It is noted that the curvature of the orbit in the
g magnets must be different from that in the main sectors.
own that the total damping decrement is always the same and
pendent of the type of damping system used.

7 AN ACHROMATIC SYSTEM OF EXTRACTION FOR PROTON SYNCHROTRONS.

Bennett and J.W.Burren.
Phys —Accelerators—Thermonuclear Res. (GB), Vol. 3,
14-16 (Jan., 1961).
achromatic modification of the Piccioni extraction system
k-focusing synchrotrons is described. A quadrupole magnet
between the target and the extraction magnet is used to
the momentum resolution of the extracted beam produced
synchrotron magnet. The extraction magnet is made radially
to give a beam of small dimensions in the exit region.

ACCELERATION OF DEUTERONS IN A SYNCHROTRON.

H.R.Shaylor and P.D.Whitaker.
(GB), Vol. 189, 741-2 (March 4, 1961).
Birmingham proton synchrotron has been adapted to
ate deuterons by modifying the system which relates the
ating voltage to the magnetic field. The energy of the
as estimated to be about 640 MeV. This was confirmed
rving the range in copper and the differential cross-section
elastic scattering of deuterons by protons. The extracted
d an intensity of 10^8 particles per pulse over an area of
at 16 m form the extractor. J.W.Sturgess

A PROPOSAL FOR INCREASING THE BEAM OUTPUT FROM A SYNCHROCYCLOTRON.

F.M.Russell.
(GB), Vol. 190, 335 (April 22, 1961).
mall dee was placed opposite the live dee at the centre of
hine covering the orbits of ions up to about 5 MeV. A high
r.f. signal was applied to it in antiphase to the live dee. It
sed on just before the main dee began to capture ions and off
ions have a few MeV energy. Increased ion intensity
because (1) the ion energy gain per turn was bigger, hence
area of phase space was available for capture; (2) ions were
d more rapidly from the high-density region, reducing the
y gas scattering; (3) the amplitude of radial oscillations was
because the field at the centre was more uniform. A 60%
of beam current was obtained at 50 MeV on the 110 in.
at Harwell, despite a 25% reduction in vertical aperture due
nall dees. J.W.Sturgess

9660 THE ENERGY DISTRIBUTION OF THE PROTON BEAM FROM THE SIX-METRE SYNCHROCYCLOTRON.

I.M.Vasilevskii and Yu.D.Prokoshkin.
Atomnaya Energiya (USSR), Vol. 7, 225 (1959). In Russian. English translation in: Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 3, No. 1, 37-41 (Jan., 1961).

The energy distribution and mean energy are given for the proton beam from the six-metre synchrocyclotron at the Joint Institute for Nuclear Studies, for various modes of acceleration. The energy spectrum is Gaussian, with a dispersion of 2.8 ± 0.3 MeV. The mean energy is accurate to 0.1%.

9661 A PLASMA BETATRON.

P.Reynolds and H.M.Skarsgard.
Plasma Phys —Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 1-2, 36-9 (Oct., 1959).

An apparatus is described in which betatron acceleration is applied to electrons in a plasma. A runaway electron current of 1 A at an energy of 2 MeV was obtained.

9662 THE EFFECT OF TARGET THICKNESS ON THE SPECTRAL DISTRIBUTION OF THE BREMSSTRAHLUNG FROM AN ELECTRON ACCELERATOR.

G.Luck.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 105-8 (March, 1961). In German.

Moderately thick targets were investigated corresponding to Lawson's third region (Abstr. 2493 of 1953). Most targets used in practice fall into this range where scattering occurs but self absorption is unimportant. The energy distribution and total intensity were measured as a function of thickness. These showed that most of the beam was formed in the upper target layers. The intensity distribution was not symmetrical about the forward direction, the peak moved towards larger angles as the target thickness was increased due to energy degradation by the scattering of the electrons. It is suggested that the spectral distribution would be a better measure of the performance of a betatron than the integral dosage rate and that the optimum target thickness for a specific set of conditions could be determined from it. J.W.Sturgess

9663 THE DESIGN AND CONSTRUCTION OF A 29 MeV MICROTRON.

D.K.Aitken, F.F.Heymann, R.E.Jennings and P.I.P.Kalmus.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 769-85 (March, 1961).

An account is given of the design and construction of a microtron having a 20 ton magnet with a pole diameter of 80 in. Details are given of the major components, phase stability is considered, and the particle dynamics relevant to vertical focusing and to beam extraction are developed. This accelerator was brought into operation in the summer of 1958, and provides an extracted electron beam of about 10^{-8} A mean at an energy of 29 MeV. The microtron is pulsed at a repetition rate of 100 pulses/sec, and has an electron pulse duration of about 2 μsec. By use of a quadrapole lens system the extracted beam can be focused to a spot about 2 mm in diameter, the corresponding angular spread being certainly less than 1^{o}.

9664 PENDULUM ANALOGUES TO ILLUSTRATE THE PARTICLE MOTION IN SPIRAL RIDGE ACCELERATORS.

J.D.Lawson, D.H.Lord and F.M.Russell.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 3, 124-9 (March, 1960).

The essential features of the motion of a particle in an azimuthally varying magnetic field of "spiral ridge" form may be described by a pair of non-linear coupled equations of simple form. These reduce to the uncoupled linear radial and vertical betatron equations when the azimuthally varying component of field is zero. In this paper two pendulum analogues are described, which obey the same equations of motion as the particles. The first of these represents the radial motion only and consists of a torsional pendulum with a magnetic moment which interacts with a rotating magnetic field; the second, which represents both radial and vertical motion, consists of a compound pendulum supported by two sets of pivots at right angles, with a magnetic bob which interacts with a travelling magnetic field. The first of these analogues was used to make an extensive survey of the maximum stable amplitude of the motion as the parameters corresponding to ridge angle, azimuthal field modulation depth and radial field index were varied. No quantitative measurement was made with the second model, but the effect of ridges in stabilizing the vertical motion was demonstrated.

X-RAY TUBES AND TECHNIQUES

9665 SOME MEASUREMENTS ON THE ABSORPTION OF 4 MV X-RAYS IN CONCRETE.
D.Greene and J.B.Massey.
Brit. J. Radiol., Vol. 34, 389-91 (June, 1961).

Measurements were made on the absorption of the primary and secondary radiation from a linear accelerator. The results give tenth-value layers for primary and secondary radiation of 12 in. and 9 in. respectively, in concrete of density 2.2 g/c.c. The distribution of tube leakage radiation, and of secondary radiation scattered from a phantom in the beam were also examined, and it it shown that scattered radiation is only significant in the forward direction.

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

9666 AN ELECTRON OPTICAL METHOD FOR THE MEASUREMENT OF MAGNETIZATION OF FERROMAGNETIC SAMPLES. C.Schwink.
Z. Phys. (Germany), Vol. 161, No. 5, 560-78 (1961). In German.

The paper deals nominally with the possibility of using an electron optical method for determining the magnetic induction of ferromagnetics. In effect it consists of a mathematical treatment of the flux distribution associated with a ferromagnetic slotted cylinder. R.Parker

ELECTROMAGNETISM

MAGNETOHYDRODYNAMICS

9667 MAGNETIC ENERGY.
E.G.Cullwick; V.C.A.Ferraro.
Nature (GB), Vol. 189, 565-6, 566 (Feb. 18, 1961).

A disputation concerning Cullwick's hypothesis that the magnetic energy of a quasi-steady conduction current is the kinetic energy of the conduction electrons. R.A.Newing

9668 NON-EQUILIBRIUM THERMODYNAMICS OF SYSTEMS IN AN ELECTROMAGNETIC FIELD. S.R. de Groot.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 188-94 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

A review is given of some applications of thermodynamics of irreversible processes to systems in the presence of an electromagnetic field. The conservation laws of mass, momentum and energy and the entropy balance equation are developed for mixtures without and with electric and magnetic polarization, and also for systems in which the momentum transfer between some of their components is inhibited.

9669 CLASSICAL ELECTRODYNAMIC EQUATIONS OF MOTION WITH RADIATIVE REACTION. G.N.Plass.
Rev. mod. Phys. (USA), Vol. 33, No. 1, 37-62 (Jan., 1961).

The solutions of the classical electrodynamic equations of motion including Dirac's radiation reaction term are studied. It is shown that the non-physical "runaway" solutions may be eliminated by an integral transformation (Abstr. 913 of 1956). The general physical solutions are obtained for the case in which the external forces are given as explicit functions of the time. A set of integral equations describing general motion in three dimensions is also given. A unique solution is shown to exist for certain range of the initial velocity. Numerous special cases are discussed. T.Erber

9670 THE CHARACTERISTIC SYSTEM FOR THREE-DIMENSIONAL, STEADY, ISENTROPIC, COMPRESSIBLE, HYDROMAGNETIC FLOWS. N.Coburn and R.S.B.Ong.
J. Math. Mech. (USA), Vol. 9, 715-32 (1960).

An analysis of the normal cone for non-dissipative steady three-dimensional magnetohydrodynamic flows leads to a demonstration of the existence at each point of three normals n, 'n, and k such that n and 'n lie in the plane determined by th local velocity and magnetic field vectors, while k is orthogonal this plane. The three families of characteristic surfaces dete by these normals are used to derive the characteristic system these flows. This system consists of twenty-six quasi-linear partial differential equations in eighteen unknown variables plu six algebraic equations. Also found explicitly are the twelve differential equations in eleven unknowns which make up the characteristic system in the special case of axial symmetry. Mathematical Reviews (H.C.Kra

9671 ON AN EXACT SOLUTION OF THE EQUATIONS O MAGNETOHYDRODYNAMICS. S.A.Regirer.
Priklad. Mat. i Mekh. (USSR), Vol. 24, 383-6 (1960). In Russia English translation in: J. appl. Math. Mech., Vol. 24, 556-61.

This paper deals with the flow of a viscous electrically conducting fluid between parallel plane walls. The author find the plane magnetic fields which give rise to the plane rectline motion of a fluid between these walls. This solution belongs to the general class of solutions recently discussed by Lin [Arc Rational Mech. Anal. (Germany), Vol. 1, No. 5 (1958)]. In the present analysis reduces to the well-known solutions given by Hartman (1937), and Lehnert (Abstr. 5579 of 1952). Mathematical Reviews (R.P.K

9672 ON THE EFFECTS OF DISSIPATION IN THE PRO GATION OF MAGNETOHYDRODYNAMIC WAVES.
J.Carstoiu.
C.R. Acad. Sci. (France), Vol. 252, No. 14, 2070-2 (April 5, 1 In French.

Waves in a compressible inviscid fluid of finite conductivi a uniform magnetic field are considered. The differential equ satisfied by the individual components of the vorticity, curren city, and the magnetic field are obtained. The differential ope involved are given in factorized form. O.P

9673 EFFECT OF TRANSVERSE MAGNETIC FIELD O FLOW DUE TO AN OSCILLATING FLAT PLATE
T.Kakutani.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1316-31 (July, 1960).

For Pt I see Abstr. 9863 of 1959. Deals with the hydrom flow of an electrically conducting fluid due to an oscillating f plate of a perfect conductor in the presence of a transverse magnetic field. Exact solutions for arbitrary values of R (the R number), R_m (the magnetic Reynolds number), and S (the magne pressure number) are first derived and then some special cases discussed corresponding to limiting values of the parameters S in order to clarify the hydromagnetic effect. A case correspo the "magnetic Stokes approximation" is discussed in some de Next, the drag on the plate is calculated for both cases of non conducting plate and perfectly conducting plate. It is found th both cases, the amplitudes of the total drag (shear-stress + Maxwell's stress) always increase, and the initial phases of t drag are always retarded for any values of R, R_m and S comp with those of the well-known classical case, i.e., the case of magnetic field and/or electrical conductivity of the fluid zer

9674 THE DIMENSIONLESS PRODUCTS CHARACTERI OF MAGNETOFLUID DYNAMICS. A.M.Pratelli
Nuovo Cimento (Italy), Vol. 19, No. 5, 903-22 (March 1, 1961 Italian.

Lists 30 independent dimensionless products which can a magnetohydrodynamics. The fundamental dimensional quant taken as length, velocity, mass density, absolute temperature magnetic field, and a constant c' which equals the speed of li the Gaussian system of units and equals 1 for the other syste Kihara's law of similitude is verified and generalized.

O.

9675 MAGNETOHYDRODYNAMIC FLOW THROUGH D OF VARIABLE CROSS SECTION. J.Rościszewsk
Phys. of Fluids (USA), Vol. 4, No. 3, 386-8 (March, 1961).

The equations governing the quasi-one-dimensional non flow of fluid of infinite conductivity through ducts of variable section, are introduced. Only one component of the magnetic is assumed to be nonzero. The equations have similarity wit of ordinary gas dynamics. Applications to several problems pointed out.

SLOW ROTATION OF AN AXIALLY SYMMETRIC BODY
IN A VISCOUS ELECTRICALLY CONDUCTING FLUID.
wal.
Fluids (USA), Vol. 4, No. 5, 651-2 (May, 1961).
effect of a uniform magnetic field on Stokes flow is
for the case in which an axially symmetric body is rotating
ly about its axis of symmetry. M.Hasan

ON THE FLOW OF A VISCOUS ELECTRICALLY
CONDUCTING FLUID. H.P.Greenspan.
ppl. Math. (USA), Vol. 18, No. 4, 408-11 (Jan., 1961).
Oseen treatment of viscous flows is extended to discuss
dy two-dimensional flow of a viscous electrically conduct-
in a magnetic field. The linearized equations are solved
nsform analysis for the flow past a rigid impermeable
finite flat plate. M.Hasan

A LIQUID CONDUCTOR MODEL OF THE HOLLOW
PINCH. B.Lehnert and G.Sjögren.
Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1,
21-3 (March, 1960).
electric current is sent through a hollow jet of mercury
flowing over the surface of a glass tube. The jet is broken
e action of the electrodynamic force. However, if at the
me a strong current is sent through a central conductor
nside the glass tube, the jet can be stabilized. This occurs
e currents are parallel. Sausage instabilities have not been
d in the present experiment.

MAGNETOHYDRODYNAMIC VIBRATIONS IN A
CYLINDRICAL CAVITY. J.Szabó.
imento (Italy), Vol. 18, No. 4, 813-17 (Nov. 16, 1960).
an.
ne modes of vibration of a perfectly conducting inviscid
ssible fluid in a cylindrical cavity of finite length are deter-
There is a magnetic field applied parallel to the axis of the
. Two simple types of vibration are possible: purely longi-
waves in which the motion is along the field lines, and purely
rse waves in which the motion is perpendicular to the field
O.Penrose

SHOCK WAVES IN MAGNETOHYDRODYNAMICS.
R.V.Polovin.
fiz. Nauk (USSR), Vol. 72, No. 1, 33-52 (Sept., 1960).
ian.
ailed theoretical review. [English translation in: Soviet
—Uspekhi (USA), Vol. 3, No. 5, 677-88 (March-April, 1961)].

ELECTROMAGNETIC WAVES AND OSCILLATIONS

(See also Plasma Oscillations)

GENERATION, AMPLIFICATION, AND DETECTION OF
INFRARED AND OPTICAL RADIATION BY QUANTUM-
NICAL SYSTEMS.
ov, O.N.Krokhin and Yu.M.Popov.
fiz. Nauk (USSR), Vol. 72, No. 2, 161-209 (Oct., 1960).
an.
iew, describing methods for obtaining negative temperature
nong infrared and optical energy levels, and the generation,
ation, and detection of electromagnetic waves by negative
ture systems. When this article was written, optical ampli-
or oscillation had not yet been achieved. 80 refs. [English
on in: Soviet Physics-Uspekhi (USA), Vol. 3, No. 5, 702-28
April, 1961). The translator (H.Lashinsky) has added a
mment on latest developments, most notably the successful
of the optical maser of Javan, Bennett,and Herriott.
dditional references are supplied by the translator].
P.M.Parker

A TWO-LEVEL MASER.
D.Bijl and C.K.Campbell.
i. (Switzerland), Vol. 13, No. Fasc. Spec., 354 (Sept., 1960).
Colloque Ampere Paper (see Abstr. 4734 of 1961). Brief
two-level maser using neutron-irradiated MgO (about 10^{18}
liquid helium temperatures and working at 3 cm wavelength.
lification at 1.3°K, (power gain)$^{1/2}$ × bandwidth ≅ 4 Mc/s.
power of the oscillation at 1.3°K is about 5 mW.

9683 ACHIEVEMENT OF A RUBY MASER USING CROSS-RELAXATION PUMPING.
R.Buisson, R.Chicault, D.Deschamps, J.Galland and M.Soutif.
C.R. Acad. Sci. (France), Vol. 252, No. 15, 2197-9 (April 10, 1961).
In French.

A ruby quantum amplifier, working at a signal frequency in the 3000 Mc/s band, has operated in conditions which allow pumping of a lower level by cross-relaxation. The conditions and performance are described. D.Walsh

9684 STIMULATED EMISSION FROM HCN GAS MASER OBSERVED AT 88.6 kMc. D.Marcuse.
J. appl. Phys. (USA), Vol. 32, No. 4, 743 (April, 1961).

9685 CALCULATION OF RESONANT FREQUENCIES OF RE-ENTRANT CYLINDRICAL ELECTROMAGNETIC CAVITIES. R.Taylor.
Plasma Phys.—Accelerators—Thermonuclear Res. (GB), Vol. 3, No. 2, 129-34 (April, 1961).

A method is described of calculating the resonant frequencies of cylindrical re-entrant electromagnetic cavities, which provides upper and lower bounds to the required frequency. These bounds converge towards each other as the number of terms in certain harmonic expansions is increased. The lower bound is increased by subtracting from the total field a singular part caused by the presence of sharp corners. Application to cavities of interest in the design of proton linear accelerators shows that accuracies of better than 1 per cent can be obtained without excessive computing time.

A MICROWAVE ANALOGUE FOR X-RAY DIFFRACTION I. EFFECT OF THE CRYSTALLITE SIZE. See Abstr. 9129

9686 THEORY AND DESIGN OF A COAXIAL SUPPORTING BEAD MADE OF COMPOSITE DIELECTRICS. G.H.Owyang.
Canad. J. Phys., Vol. 39, No. 6, 926-34 (June, 1961).

The effect due to the presence of a single supporting bead made of composite dielectrics in a coaxial line is being studied. A formula correlating the standing wave ratio caused by the bead and the physical parameters of the bead is derived. A bead of this type may be designed to have very low voltage standing wave ratio (VSWR) over a very wide band of frequency. A typical design using quartz and air as dielectrics is given, and the calculated VSWR is below 1.003 over a bandwidth whose maximum to minimum frequency ratio is as high as 13:1.

9687 PROPAGATION OF CENTIMETRIC WAVES IN WAVEGUIDES FILLED WITH PLASMA FROM THE POSITIVE COLUMN OF A DISCHARGE. I.
V.E.Golant, A.P.Zhilinskii, M.V.Krivosheev and G.P.Nekrutkina.
Zh. tekh. Fiz. (USSR), Vol. 31, No. 1, 55-62 (Jan., 1961). In Russian.

A hot cathode discharge produced the plasma in helium and argon at pressures from 0.05 to 10 mm Hg, with currents ranging from 5 to 100 mA. The electrical characteristics of these plasmas were investigated with 3 and 10 cm microwaves. The strength of the microwave field was kept small to avoid any appreciable perturbation in the plasma. The phase- and damping constants for homogeneous waveguides filled with homogeneous plasma were measured under various experimental conditions. The set-up is illustrated schematically and the results are given in a number of diagrams. [English translation in: Soviet Physics–Technical Physics (USA)]. G.Martelli

9688 PROPAGATION OF CENTIMETRIC WAVES IN WAVEGUIDES FILLED WITH PLASMA FROM THE POSITIVE COLUMN OF A DISCHARGE. II.
V.E.Golant, A.P.Zhilinskii and M.V.Krivosheev.
Zh. tekh. Fiz. (USSR), Vol. 31, No. 1, 63-70 (Jan. 1961). In Russian.

For Pt I see preceding abstract. The non linear effect which accompany the propagation of centimetric waves in the plasma of the positive column of a discharge are investigated. The dependence of the propagation of the microwaves on the voltage of the v.h.f. field is studied in the range where the interaction of the field with the plasma is not negligible. The results obtained are in good agreement with theoretical predictions. [English translation in: Soviet Physics–Technical Physics USA]. G.Martelli

9689 SCATTERING OF RADIO WAVES BY AN IONIZED GAS IN THERMAL EQUILIBRIUM IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD. J.A.Fejer.
Canad. J. Phys., Vol. 39, No. 5, 716-40 (May, 1961).

In an earlier paper (Abstr. 17108 of 1960) a theory was developed for the scattering of radio waves by the electron density fluctuations that exist in an ionized gas in thermal equilibrium. The theory treated only the extreme cases where the "characteristic scale" of the scattering irregularities is either very much larger or very much smaller than the Debye length. The presence of only one type of singly charged ion was considered and the ion and electron temperatures were assumed equal. The effects of an external magnetic field were not taken into account. These earlier limitations are removed in the present paper and the effects of an external magnetic field are taken into account. It is shown that the total power is independent of the magnetic field and an expression for the frequency spectrum of scattered power in the presence of a uniform magnetic field is obtained. Useful approximations to this expression are derived for various limiting cases of interest. It is concluded that the magnetic field need not be taken into account in the interpretation of past observations by Bowles (Abstr. 3677 of 1959) and by Pineo, Kraft and Briscoe (Abstr. 16432 of 1960). In future experiments, however, particularly at great heights, the effect of the magnetic field could be considerable.

9690 THE QUASI-LONGITUDINAL APPROXIMATION TO THE APPLETON—HARTREE EQUATION. A.D.M.Walker.
Nature (GB), Vol. 189, 742-3 (March 4, 1961).

The limitations of the usual approximation are pointed out, and the next higher approximation is quoted. D.M.Gilbey

RADIOWAVE RECEPTION FROM ARTIFICIAL SATELLITES AND ROCKETS. See Abstr. 9303

Radiofrequency Spectroscopy Techniques

9691 A MICROWAVE SPECTROGRAPH WITH BACKWARD-WAVE OSCILLATORS AS RADIATION SOURCES. MICROWAVE SPECTRUM, STRUCTURE AND HINDERED INTERNAL ROTATION OF DIMETHYL SULFIDE.
H.Dreizler, W.Maier and H.D.Rudolph.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 137 (Sept., 1960).

The authors have successfully operated a 30 kc/s square-wave Stark-modulation microwave spectrograph employing backward-wave oscillators as radiation sources and completely covering the frequency range from 8 to 37.5 Mc/s with 4 such tubes. The b.w.o.'s are i.f.-stabilized against the harmonics of a quartz-controlled yet continuously variable frequency standard (600-1000 Mc/s), resulting in a source noise as low as with the best klystron sources. Tuning is effected by variation of the standard frequency. Brief results obtained on $(CH_2)_2S$ are given.

9692 SENSITIVE TRIPLE MODULATION METHOD FOR MEASURING WIDTHS OF MICROWAVE SPECTRAL LINES. E.A.Rinehart and C.C.Lin.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 562-3 (May, 1961).

A method was devised for the measurement of microwave spectral line widths with high sensitivity. This method consists of a combined source modulation of the microwave power at 2.3 kc/s and Stark modulation at 100 kc/s in addition to the slow sawtooth sw voltage. The use of two r.f. modulations eliminates the base line whi arises from the variation of the klystron power with frequency. The base remains flat for a source modulation amplitude as high as 1 W. The sensitivity is greatly improved over the previo method in which only source modulation is used. It is suggested the technique of triple modulation may also be used to resolve closely spaced lines.

9693 COMPENSATION FOR FLUCTUATIONS IN SOURCE-FREQUENCY IN ELECTRON RESONANCE SPECTRO METERS. A.Redhardt.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 108-11 (March, 1961).
In German.

An arrangement is described in which two nearly equivalent resonators, one being the spectrometer cell, are coupled in a bri arrangement between the source klystron and the receiver. The compensation is analysed mathematically for the real and imagin parts of the change in the reflected wave for a given frequency change. The relative changes in frequency which can occur witho the resultant changes in waves reflected from the measuring cav becoming greater than fluctuations due to thermal noise, are sho to be some 10^3-10^4 greater than in a simple one-resonator arrang ment. Experimentally, it is shown that a compensation for frequency fluctuations greater than the width of the resonator respons can be achieved. J.Sheri

9694 PARAMAGNETIC RESONANCE SPECTROMETRY AT ZERO MAGNETIC FIELD. G.S.Bogle, H.F.Symmon V.R.Burgess and J.V.Sierins.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 561-6 (March, 1961).

The need for direct measurements of paramagnetic resonan absorption spectra in zero magnetic field is discussed. Two spe meters were built which together cover the range of 8 to 18 Gc/s with one of these a spectrum is recorded over a range of nearly 6 Gc/s in a time of two minutes with a sensitivity sufficient to d about 10^{17} Fe^{3+} ions at 80°K. Polycrystalline samples may be u and examples are shown of the spectra of a dilute ferric chelate compound. A technique is described for obtaining the absorptio line shape free from the effects of the associated anomalous dispersion.

9695 APPARATUS FOR MEASURING NUCLEAR QUADR POLE RESONANCE AT FREQUENCIES OF THE ORDER OF 1 Mc/s. P.Bucci.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 656 (Sept., 19
In French.

9th Colloque Ampere Paper (See Abstr. 4734 of 1961). Brie note substantially as follows. The apparatus operates by subje the sample to r.f. impulses and observing after each pulse the si induced by the precession of the nuclei. A heterodyne system allows the use of matched amplifiers. By integrating over a tim for a pulse repetition frequency of f, one obtains an improvemen signal-to-noise ratio of $\sqrt{ft}$. The apparatus does not require rap modulation.

NUCLEAR PHYSICS

596 THE USE OF THE TERM "FLUX".
S.C.Ghose and J.C.Young.
e (GB), Vol. 190, 621 (May 13, 1961).
Considers the confusion, particularly in nuclear physics, en the terms "flux" and "flux density". The generally ted meaning is that flux = flux density × area. Referring to a ole unit of neutron flux, the chad (Abstr. 509, 7248 of 1961), it gested that this be defined as a unit of flux density, its sions being $NL^{-2}T^{-1}$.

APPARATUS
PARTICLE DETECTORS

(Counting circuits are included under Electrical Measurements and Circuits)

DEPARTURES FROM THE PHOTOELECTRIC PROPORTION-Y LAW IN GAS-FILLED PHOTOCELLS IN THE LOW RENT AND ANOMALOUS GLOW REGIONS. See Abstr. 9636

597 USE OF AN IONIZATION CHAMBER FILLED WITH A DIELECTRIC LIQUID AT ROOM TEMPERATURE.
nc, J.Mathieu and J.Boyer.
Cimento (Italy), Vol. 19, No. 5, 929-38 (March, 1961).
ench.
The performance of an ionization chamber filled with pure e at room temperature was investigated. The ionization nt produced by the γ-radiations from a Co^{60} source was to be about 100 times greater than the residual current. over the ionization current was found to increase linearly as tion of the applied voltage up to a certain critical voltage d which the current increases exponentially. This is attributed process of ionic multiplication in the liquid similar to the observed in gases. The utility of this type of ionization ber as a detector of α-particles, fast neutrons and γ-radiations phasized. J.B.Garg

98 SPARK CHAMBER SYMPOSIUM.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 480-531
1961).
The symposium was held at the Argonne National Laboratory bruary 7, 1961. A full account is given of three papers and subsequent discussion, together with an Appendix of six other s presented. For abstracts of these papers see following acts and succeeding issues of Physics Abstracts.

99 DEVELOPMENT OF THE SPARK CHAMBER: A REVIEW. A.Roberts.
sci. Instrum. (USA), Vol. 32, No. 5, 482-98 (May, 1961).
park Chamber Symposium, see Abstr. 9698 of 1961. A of the development of the spark chamber from the counter is given. An effort has been made to clarify the early y of the device. Some unpublished recent Russian work on chambers is summarized. A consistent terminology for the s times relevant to spark chamber operation is suggested.

00 OBSERVATIONS ON PULSED SPARK CHAMBERS.
J.Fischer and G.T.Zorn.
sci. Instrum. (USA), Vol. 32, No. 5, 499-511 (May, 1961).
park Chamber Symposium, see Abstr. 9698 of 1961. The formation time in rare-gas pulsed spark chambers was gated as a function of the pulse voltage under various conditions trodes, gap lengths, gases, delay times, and clearing fields. lanation of these formation times was found in terms of a process of electron multiplication leading to rapid gas break-Notes on the construction of a thin foil spark chamber and on ron pulsers for use with spark chambers are also given.

9701 A 14 × 14 × 7 in. THIN PLATE SPARK CHAMBER.
D.I.Meyer and K.M.Terwilliger.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 517-18 (May, 1961).
Spark Chamber Symposium, see Abstr. 9698 of 1961. A Lucite wall spark chamber with 0.012 in aluminium electrodes, active dimensions 14 × 14 × 7 in., was constructed and tested both with cosmic rays and a particle beam. The gap efficiency is nearly 100% and the time resolution ~1 μsec. Construction methods and chamber characteristics are presented.

9702 ACCURACY OF TRACK LOCATION IN SPARK CHAMBERS. I. J.G.Rutherglen and J.M.Paterson.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 519-21 (May, 1961).
Spark Chamber Symposium, see Abstr. 9698 of 1961. Several spark chambers with a sensitive area of about 6 × 6 in. were constructed using 0.005 in. aluminium plates and 0.25 in. glass frames as spacers. These were tested with cosmic rays, using neon, argon, and neon—argon mixtures as the filling gas. A spark gap triggered by scintillation counters was used to apply a high voltage pulse to the plates. Photographs of the sparks produced were analysed to determine the accuracy with which the track of the cosmic ray could be located. It was found that the electrons nearest the negative electrode are the ones which determine the position of the spark. The results give a basis on which to design a spark chamber system to give any desired accuracy of track location and direction.

9703 ACCURACY OF TRACK LOCATION IN SPARK CHAMBERS. II. J.G.Rutherglen and J.M.Paterson.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 522-3 (May, 1961).
Spark Chamber Symposium, see Abstr. 9698 of 1961. For Pt I see preceding abstract. Some improvements in technique and a number of new measurements were made. The principal change in the electronics was in the circuit used to fire the triggered spark gap. The total delay time between the photomultiplier pulse and the firing of the triggered gap was reduced to 0.19 μsec, so that the minimum over-all delay, including the transit time in the photomultipliers is about 0.25 μsec. The jitter in this time is less than 0.01 μsec. The rise time of the pulse applied to the chamber was less than 0.02 μsec. Some tests were made with pure helium and with mixtures of helium and argon. The addition of argon increases both the specific ionization and the starting voltage, and reasonable compromise was found to be a mixture of 75% helium and 25% argon, which has a starting voltage of about 5 kV and a specific ionization about twice that for pure helium.

9704 USE OF A PURE NaI SCINTILLATOR AS A γ-RAY DETECTOR IN A FAST COINCIDENCE CIRCUIT.
M.Vergnes and R.David-Boyer.
J. Phys. Radium (France), Vol. 21, No. 1, 65-7 (Jan., 1960).
In French.
The sensitivity and decay time of a pure NaI scintillator cooled to liquid nitrogen temperature and a thalium activated NaI scintillator at room temperature were investigated in order to assess the utility of the former as a γ-ray detector in a fast coincidence circuit. The decay time of the pure NaI crystal was found to be four times shorter than the NaI(Tl) scintillator and the light output was found to be smaller by a similar factor. The time resolution (t) of a fast coincidence circuit using these scintillators was measured by observing γ—γ coincidences from a Gd^{153} source. A value of t = 1.8 nsec was obtained with the pure NaI scintillator as compared to t = 2 nsec obtained with the NaI(Tl) scintillator. However, the γ-ray energy resolution of the pure NaI crystal was found to be worse than the NaI(Tl) scintillator. J.B.Garg

9705 METHOD FOR DETERMINING THE PHOTOPEAK EFFICIENCY OF SCINTILLATION COUNTERS.
J.B.Ashe and J.H.McCrary.
Rev. sci. Instrum. (USA), Vol. 32, No. 2, 205-6 (Feb., 1961).
It is shown that the Photopeak Efficiency, of a counter subtending 4π sr at a source, for 0.511 MeV photons, can be obtained by using a positron emitter (the strength of which need not be known) and comparing the number of counts corresponding to the simultaneous detection of both photons of the annihilation radiation with the total number of counts. The strength of the source can be determined when the Photopeak Efficiency is found. J.L.Redding

9706 LARGE GAS ČERENKOV COUNTER.
R.J.Swanson and G.E.Masek.

Rev. sci. Instrum. (USA), Vol. 32, No. 2, 212 (Feb., 1961).

The counter uses CO_2 and is 2.2 m long. At pressures of about 40-50 p.s.i.g. the counter has an efficiency of 95% for muons of momentum 2 GeV/c (β = 0.9986) but only about 0.2% for pions of the same momentum (β = 0.9976). J.L.Redding

9707 ON THE DETECTION OF SINGLE IONS WITH THE ION—ELECTRON CONVERTER.
F.Bernhard, K.H.Krebs and I.Rotter.

Z. Phys. (Germany), Vol. 161, No. 1, 103-15 (1960). In German.

The method is based on the release of secondary electrons from a metal surface under positive ion bombardment. The apparatus consists of a mass spectrometer, using a magnetic deflection of 60° with second order focussing and resolving power of 600 and bakeable to 300°C before being evacuated by a Hg diffusion pump to 10^{-7} mm Hg, an ion—electron convertor with a Ni target and a two electrode arrangement focussing the electrons on the scintillator (CsI crystal or ZnO polycrystalline layer), and a photomultiplier. The output pulses were fed into an amplifier with a gain of 10 and counted by means of a decade scaler. The pulse amplitude distribution was obtained with a 100-channel analyser. The results of measurements of the secondary electron yield from Ni are shown graphically as function of ion energy for Xe^+ and Hg^+, and as function of mass number for 10 kV hydrocarbon molecular ions of the group $C_4H_{2n}^+$ arising from the residual gas. I.C.Demetsopoullos

Track Visualization

9708 THE SIZE OF GRAINS DURING PRECIPITATION OF NUCLEAR EMULSIONS. I.Batthyany and P.Demers.

Canad. J. Phys., Vol. 39, No. 4, 608-9 (April, 1961). In French.

An electron microscope was used to study the effect of the variation of stirring speed on the size of the precipitated grains in the double jet method. It is found that the relation between the speed of the stirrer and the size of grains has the Gaussian form. S.J.St-Lorant

9709 DETERMINATION OF THE SENSITIVITY OF ILFORD G0 AND G2 EMULSIONS.
M.Morand, S.Desprez-Rebaud and M.Betrencourt.

C.R. Acad. Sci. (France), Vol. 252, No. 15, 2212-13 (April 10, 1961). In French.

The sensitivities determined are 3200 eV for G0 and 1500 eV for G2 emulsion respectively. The theoretical curve of grain density versus the residual range is in good agreement with the experimentally observed values. S.J.St-Lorant

9710 DISCRIMINATION BETWEEN α - TRACKS AND γ - BACKGROUND IN ILFORD NUCLEAR EMULSIONS.
K.van Camp, M.Dorikens and L.Dorikens-Vanpraet.

Nature (GB), Vol. 190, 38-9 (April 1, 1961).

An attempt is made to improve the discrimination between α particles and γ background by making use of the Herschel effect. With phenosafranine as desensitizer all the types of Ilford nuclear emulsion with the exception of C2 and K0 showed some improvement in the discrimination. Pinacryptol yellow proved useless as a desensitizer. S.J.St-Lorant

9711 SENSITIVITY OF ILFORD Q_1 PLATES.
E.Burlefinger and H.Ewald.

Z. Naturforsch. (Germany), Vol. 16a, No. 4, 430-1 (April, 1961). In German.

A linear relation is shown to connect ion density and the number of grains developed per unit area, for positive ions of H, Ne and A. A table is given of relative sensitivities to ions from H to Xe. S.T.Henderson

9712 INVESTIGATIONS ON THE PREPARATION OF NUCLEAR TRACK EMULSIONS. A.Narath and G.Heimann.

Z. wiss. Photogr. (Germany), Vol. 54, No. 7-9, 130-52 (1960). In German.

Methods of emulsion preparation are surveyed, and details given of a process of precipitation in very dilute solution followed by coagulation with methyl or ethyl alcohol. Ripening by ammonia and sensitization by a pyrazole derivative and triethanolamine are discussed. Emulsion sensitivity may be measured by Sr^{90}, or by neutrons from Ra—Be; a grey scale is described, produced by exposure to areas of a flat plate incorporating a range of concentr tions of uracil labelled with C^{14}. Curves of blackening on this sca are shown, also photographs of particle tracks. In the latter case the optimum emulsion preparation varies according to the kind of particle. S.T.Henders

NUCLEAR FIELD THEORY

9713 ON THE AXIOMS OF QUANTUM FIELD THEORY.
W.Weidlich.

Nuovo Cimento (Italy), Vol. 19, No. 2, 277-91 (Jan. 16, 1961).

A set of axioms for quantum field theory is discussed, which differs somewhat from that of Lehmann, Symanzik and Zimmerma while retaining Lorentz-invariance, the asymptotic condition and causality. The starting point is the non-relativistic canonical fiel theory, which is then extended to the relativistic case. Because o Haag's theorem the concept of local causal field has to be generalized. I.J.R.Aitchis

9714 A SOLVABLE MODEL OF FIELD THEORY.
E.R.Caianiello and A.Campolattaro.

Nuovo Cimento (Italy), Vol. 20, No. 2, 422-6 (April 16, 1961).

A Dirac spinor field coupled scalarly to a neutral boson field whose free propagator is a constant is considered. The one particle propagation kernel is evaluated explicitly and the connection with charge renormalization exhibited. D.W.L.Spr

9715 ON THE YANG—MILLS FIELD.
P.Hillion and J.P.Vigier.

C.R. Acad. Sci. (France), Vol. 252, No. 8, 1113-15 (Feb. 20, 1961). In French.

It is shown that the Yang—Mills field does not possess a proper mass, but that there exists a coupling energy between the three vector components of this field. R.F.Peie

9716 ON THE COMPLETENESS OF LORENTZ INVARIAN FIELDS IN A TIMELIKE TUBE. H.J.Borchers.

Nuovo Cimento (Italy), Vol. 19, No. 4, 787-93 (Feb. 16, 1961). In German.

It is shown, as a consequence of Lorentz invariance and the spectrum condition, that a complete field is complete in a timel tube. E.J.Squ

9717 ON SEVERAL PROPERTIES OF THE GENERATING FUNCTION FOR PROPAGATORS IN QUANTUM ELECTRODYNAMICS. A.Visconti and H.Umezawa.

C.R. Acad. Sci. (France), Vol. 252, No. 13, 1910-12 (March 27, 1961). In French.

9718 FINITE PERTURBATION THEORY IN QUANTUM ELECTRODYNAMICS. I.Bialynicki-Birula.

Phys. Rev. (USA), Vol. 122, No. 6, 1942-6 (June 15, 1961).

It is proved that no infinities appear in the power series expansion of the S-matrix in quantum electrodynamics if one uses a improved perturbation procedure which is based on the following property of all renormalizable field theories. The dependence o solutions on the coupling constant has a singular part, nonanalyti at g = 0. This singular dependence must be treated exactly, whe as the remaining, nonsingular, dependence can be expanded into power series. This power series coincides with the standard re normalized expansion. All renormalization constants in every o remain finite, provided their singular dependence on the couplin constant is treated exactly. The problem of convergence of the whole series has not been investigated.

9719 PHOTONS INTERACTION WITH A HOMOGENEOUS CONSTANT MAGNETIC FIELD. A.Minguzzi.

Nuovo Cimento (Italy), Vol. 19, No. 4, 847-9 (Feb. 16, 1961).

In continuation of earlier papers (Abstr. 7960 of 1956; 499 o 1958; 34 of 1959), the following points are discussed: (1) analyti properties in the variable $\sqrt{e^2 h_{\mu\nu} h_{\mu\nu}}$; (2) branch points of the ind of refraction; (3) lifetime for the process $\gamma \rightarrow \gamma' + \gamma''$. P.K.Ka

9720 TENSOR ISOTENSORS.
J.Géhéniau and J.Nuyts.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 10, 826-33 (1960 In French.

The products of the components $\phi_{a\alpha}$ of a spinor isospinor (a = 1, 2; α = 1, 2, 3, 4) are the components of tensors reducible

:oups of Lorentz $L_{\ddagger}$, Pauli—Gürsey, and Touschek. A re-
on is made for the case where the $\phi_{a\alpha}$ anticommute. The
ts are summarized in a final table. Each irreducible tensor
nsor is characterized by three numbers: the baryonic number
ne isospin t and the indices p/2, q/2 of the $L_{\ddagger}$ representation
-q/2.

721 COUPLING OF DIRAC PARTICLE AND GRAVITATIONAL FIELD. T.Kimura.

:. theor. Phys. (Japan), Vol. 24, No. 2, 386-406 (Aug., 1960).
By using legs connection the author investigates the general
.vistic Dirac equation which is invariant under the general
linate transformations and spin transformations. The four-
nsional representation for the generalized Dirac matrices is
ned by introducing the six legs and the concept of sedenion
gate. It is shown that Fermi—Fermi interaction term must
ded to the original Lagrangian density, if the legs connection
garded as independent field quantity. The electromagnetic
is also introduced in connection with the complex legs.
ly, the relation between the spin transformation and Pauli—
ey type transformation is considered.

722 ON A UNIFIED DESCRIPTION OF ELEMENTARY PARTICLES. M.Taketani and Y.Katayama.

r. theor. Phys. (Japan), Vol. 24, No. 3, 661-78 (Sept., 1960).
A scheme of approach to the unified description of elementary
cles is proposed by using the "neutrino" and the concept of
rge-on". The electron and muon are considered as two kinds of
rically (ϵ-) charged-on neutrino, and the proton, neutron and
rticle are baryonically (b-) charged-on neutrino, electron and
, respectively. The interactions are constructed from the
rents of charge": The fundamental strong interaction is the
arged and conserved current—current type where the full
a—Ogawa—Ohnuki's) symmetry among three baryons auto-
cally holds and the fundamental electromagnetic interaction is the
arged and conserved current—current type (action at a distance),
the weak interactions consist of the ϵ-charge fading current—
ent type (usual weak), the b-charge fading current—current
and the b- and ϵ-charge fading current—current type (both are
mely weak). Their relation is considered genetically by using
-charge-on process (Gamba—Marshak—Okubo's symmetry)
he ϵ-charge-on process.

723 A CRITERIUM FOR THE STABILITY OF A NEUTRAL ZERO SPIN PARTICLE PREDICTED BY A CLASSICAL LINEAR FIELD THEORY. O.Hellman.

Acad. Sci. Fennicae A VI (Finland), No. 71, 9 pp. (1960).
stability theory for the elementary particles predicted by a
near field equation generalized from the cubic scalar field
ion is suggested. The application of the theory to the lightest
entary particle predicted by this equation results in the
bility of this particle, in an agreement with the phase-plane
lations by Finkelstein et al. (Abstr. 6742 of 1951).

724 A CLASSICAL NONLINEAR FIELD THEORY PREDICTING MASSES OF NEUTRAL AND CHARGED MENTARY PARTICLES WITH ZERO SPIN. O.Hellman.

Acad. Sci. Fennicae A VI (Finland), No. 72, 12 pp. (1960).
method for calculating the electromagnetic correction to the
es predicted by a classical nonlinear scalar field theory
r. 6742 of 1951) is introduced. It turns out that only by
; into account the electromagnetic field is one able to calculate
experimental data all the three unknown constants of this
ical nonlinear field theory. Furthermore, calculations which
ct the electromagnetic field would lead to a mass spectrum
the charged particles are always heavier, in contradiction
he experimental result that $M_{\pi^0} < M_{\pi^\pm}$ but $M_{K^0} > M_{K^\pm}$.
lations are carried out for the case of a cubic field equation.
ree constants of the theory are obtained from the π-meson
nd the masses of the neutral and of the charged particles,
sponding to the next eigensolution of the field equation are
lated. It turns out that now the neutral particle is heavier.
ubic equation does not, as is well known, predict the masses
π^0 and the K^0 mesons correctly. The problem is formulated
more general nonlinearity (Φ^{2N-1} instead of Φ^3) and it is
that future calculations would reveal a N-value which would
o the correct π^0 and K^0 masses.

9725 QUATERNION FORMULATION OF THE THEORY OF THE NON-RELATIVISTIC TOP. F.Halbwachs.

C.R. Acad. Sci. (France), Vol. 252, No. 11, 1568-70 (March 13, 1961). In French.

The state of the top is represented in terms of the motion of a point on a hypersphere S_3 in a Euclidian 4-space. Quantization could be effected as for a point particle with allowance for the Riemannian metric of S_3. The theory is invariant under the group of rotations in 4-space, and a quaternion formulation is used to derive the infinitesimal operators of this group. R.A.Newing

9726 ON THE CLASSICAL MODEL OF BOPP AND HAAG FOR PAULI PARTICLES. J.Penné.

C.R. Acad. Sci. (France), Vol. 252, No. 13, 1913-15 (March 27, 1961). In French.

It is claimed that the introduction of Euler angles describing the orientation of an arbitrary fixed framework attached to the spherically symmetrical structure of the particle leads to the result of Bopp and Haag (Abstr. 4110 of 1951) and at the same time demonstrates the necessity of representing the state of the particle by a two-component spinor taking the matrices $\frac{1}{2}\hbar\sigma_K$ as operators of angular momentum. P.K.Kabir

9727 MAJORIZATION OF FEYNMAN DIAGRAMS. A.A.Logunov, A.N.Tavkhelidze, I.T.Todorov and N.A.Chernikov.

Dokl. Akad. Nauk SSSR, Vol. 135, No. 4, 801-4 (Dec. 1, 1960). In Russian.

For abstract, see Abstr. 3124 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1198-201 (May-June, 1961)].

9728 ON THE CONSERVATION OF ISOFERMIONS AND THE RULE $\Delta S = \Delta Q$ IN WEAK PROCESSES. W.Królikowski.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys. (Poland), Vol. 9, No. 1, 43-5 (1961).

Assigns isotopic spins and strangenesses to leptons. The rule $\Delta S = \Delta Q$ for the strangeness-changing part of the weak current seems more probable than the conservation rule $\Delta Y = 0$, where Y is the isofermion number. J.E.Paton

9729 SOME CONSIDERATIONS ON GLOBAL SYMMETRY. T.D.Lee and C.N.Yang.

Phys. Rev. (USA), Vol. 122, No. 6, 1954-61 (June 15, 1961).

If the recently discovered Y^* state in the $\Lambda\pi$ system (Abstr. 3240 of 1961) is related to the $T = \frac{3}{2}$, $J = \frac{3}{2}$ resonance in πp scattering, global symmetry considerations should become relevant. In this paper, global symmetry is discussed with a view to understanding its group structure. Also discussed is a possibility of reconciling the conflict, pointed out by Pais, between certain experimental results and global symmetry. The partial widths of the Y^* state are calculated and also those of the companion excited states Z^* and Ξ^*. A generalization of the quantum number G is discussed.

9730 SYMMETRIES OF THE INTERACTIONS AMONG STRONGLY INTERACTING PARTICLES AND NON-LEPTONIC DECAYS OF HYPERONS. K.Fujii.

Progr. theor. Phys. (Japan), Vol. 24, No. 2, 259-70 (Aug., 1960).

A symmetry law which can hold true in both strong and weak interactions among the strongly interacting particles is investigated and an example is given. The requirement of invariance under the proposed symmetry transformation and some assumptions lead to interactions which give consistent results with experiments of $\Sigma\pm$ and Λ decays. The implications of such a symmetry law are discussed and the problems concerning the K-meson decay into two pions are mentioned.

9731 SYMMETRY OPERATIONS FOR STRONG AND WEAK INTERACTIONS. V.Gupta.

Nuovo Cimento (Italy), Vol. 19, No. 4, 821-4 (Feb. 16, 1961).

The invariance of a general N—N—π Lagrangian (Abstr. 17383 of 1960) under G-conjugation and the product of time reversal and charge symmetry leads to a parity conserving interaction. Extensions to kaon—baryon and weak interactions are considered. J.S.Dowker

9732 UNIVERSALITY OF COUPLING CONSTANTS AND INDIVIDUAL Γ_5-INVARIANCE. K.Iwata.

Progr. theor Phys. (Japan), Vol. 24, No. 2, 308-16 (Aug., 1960).

The characteristics of the interaction of elementary particles are summarized as "universality" and a sort of invariance called "individual Γ_5-invariance". These are suggested as the requisites of forthcoming theories. The limit of applicability of (V-A)-type weak interaction in the high-energy region is also noted.

TEST OF ISOTOPIC SPIN CONSERVATION FROM AN EXPERIMENT LIMIT ON $\sigma(d + d \rightarrow He^4 + \pi^0)$. See Abstr. 9776

9733 NON-LOCALITY IN THE SECOND ORDER POTENTIAL. R.L.Carovillano.

Progr. theor. Phys. (Japan), Vol. 24, No. 3, 614-28 (Sept., 1960).

The non-local properties of the second-order two-nucleon interaction are investigated using ps-ps meson theory and the Tamm—Dancoff approach. None of the customary transformations are applied to the potential or wave-function, so the second-order potential derived is both momentum-dependent and energy-dependent. The potential is hermitian, however, so that the two-nucleon component of the wave-function can be normalized in the usual manner, conserving probability. The size of the non-local corrections on scattering states is estimated as a function of energy and as a function of the internucleon separation distance. The Born approximation is used to show that the lowest-order velocity correction accounts for almost all of the non-local corrections at 300 MeV laboratory energy where it decreases the static scattering amplitude by about 25%. The energy dependence of the potential is instrumental for the Born approximation scattering amplitude being the same as given by lowest-order S-matrix theory. The non-local corrections are estimated as a function of internucleon distance by defining an "effective" scattering potential which disguises most of the velocity terms as a static fourth order potential. Velocity corrections are found to be very large in triplet states, dominating over the static second order potential at about 1.5-3.0 f. Comparison with the potentials of others where various transformations have been employed is discussed. There is no spin—orbit component in the second order ps-ps potential, but the corresponding potential derived from scalar meson theory does have such a component. The latter calculation suggests that a spin—orbit potential should really be regarded as a quadratic momentum dependence and therefore does not have an a priori preference over other admissible quadratic dependences.

9734 FIELD-THEORETICAL DERIVATION OF THE TWO-BODY POTENTIAL. S N.Gupta.

Nuovo Cimento (Italy), Vol. 18, No. 4, 823-4 (Nov. 16, 1960).

A justification is offered for the neglect of all velocity-dependent terms in the author's derivation (Abstr. 5511 of 1960) of the non-relativistic nuclear potential. I.J.R.Aitchison

9735 SPIN—ORBIT INTERACTION IN TWO-PION EXCHANGE NUCLEAR POTENTIAL. S.N.Gupta.

Phys. Rev. (USA), Vol. 122, No. 6, 1923-6 (June 15, 1961).

The spin—orbit interaction term in the two-pion exchange nuclear potential (Abstr. 5511 of 1960) is derived. It is found that while the spin—orbit force is quite small in the triplet odd states, it is large and repulsive in the triplet even states. The relationship of the pion theoretical result with the phenomenological spin—orbit interaction is discussed.

9736 DISPERSION RELATIONS FOR PRODUCTION AMPLITUDES. Y.S.Kim.

Phys. Rev. Letters (USA), Vol. 6, No. 6, 313-15 (March 15, 1961).

The analytic properties of the amplitude for the process $\pi + N \rightarrow \pi + \pi + N$ are discussed. A particular perturbation diagram is analysed to show that this amplitude has complex singularities as a function of the variables in which previous workers have written dispersion relations for this process. R.F.Peierls

FORMAL THEORY OF REARRANGEMENT COLLISIONS. See Abstr. 9327

9737 TWO CHANNEL REACTIONS IN RELATIVISTIC DISPERSION THEORY. R.Oehme.

Z. Phys. (Germany), Vol. 162, No. 2, 426-37 (1961).

Reactions involving two coupled two-particle channels are studied, the reactions $\pi + Y \rightarrow \pi + Y$, $\bar{K} + N \rightarrow \bar{K} + N$, $\pi + Y \rightarrow \bar{K} + N$ without spin and isospin complications, being chosen as a model. The dynamical singularities and physical branch lines of the three s-wave amplitudes are described. These amplitudes are continued through the physical branch lines onto the four-sheeted Riemann surface, and the analytic properties of their dispersive and absorptive parts are found. The connection between poles in unphysical sheets and possible resonances is investigated I.J.R.Aitchison

PERTURBATIVE TREATMENT OF PAIRING FORCES IN MANY-FERMION SYSTEMS. See Abstr. 9348

ELEMENTARY PARTICLES

9738 AN ATTEMPT AT A PHENOMENOLOGICAL THEOR OF THE PROPER MASSES OF ELEMENTARY PARTICLES. O.Costa De Beauregard.

C.R. Acad. Sci. (France), Vol. 252, No. 9, 1276-8 (Feb. 27, 1961) In French.

9739 TWO CHANNEL FIVE NUCLEON REACTIONS WITH CENTRAL FORCES.

W.Laskar, C.Tate, B.Pardoe and P.G.Burke.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 1014-23 (May, 1961).

The reaction was formulated using the resonating group meth and including the two groupings dt, nHe^4. The central potential u is of Gaussian shape with exchange dependence (Serber and symmetrical exchange were mainly investigated). The wave-func for the nuclear ground states are Gaussian (double Gaussian for deuteron and single Gaussian for t and He^4) the parameter being determined by variational methods to fit the binding energies. Coupled integro-differential equations were derived for each valu of the total spin and angular momentum of the corresponding syst Numerical results were obtained and are given here.

Photons

9740 LINEARLY POLARIZED GAMMA RAYS FROM NUCLEAR REACTIONS. A.E.Litherland and H.E.Gov

Canad. J. Phys., Vol. 39, No. 3, 471-3 (March, 1961).

It can be shown from the results of angular distribution meas urements (Abstr. 3960 of 1956; 12536 of 1959) that the 1.37 MeV γ-rays emitted at 90° to the incident proton beam in the reaction $Mg^{24}(p,p'\gamma)$ at the 2.01 and 2.43 MeV proton resonances should be almost 100% linearly polarized. This prediction was success fully verified at both resonances by measuring the angular distr bution of Compton scattered radiation from a sodium iodide cry scattered at 90° to the incident 1.37 MeV γ-rays which were them selves emitted at 90° to the proton beam in the above reaction. Coincidences were recorded between recoil electrons in the sca ing crystal and scattered quanta in a second crystal which could be rotated about the target-scattering crystal axis. Measureme of linear polarization and angular distributions from similar re tions can yield the parity change in γ-transitions. Measuremen of the linear polarization of the 1.64 MeV γ-ray from the secon excited state of N^{14} and of the 0.94 MeV γ-ray from the first excited state of F^{18} show that the 0.94 MeV state and the ground state of F^{18} have the same parity and similarly that the 3.95 and 2.31 MeV states of N^{14} have the same parity. Such measurement together with angular distribution data from capture reactions ca give unambiguous information about dipole—quadrupole mixtures R.E.Me

9741 A MATHEMATICAL METHOD OF ANALYSIS FOR PREDICTING THE PERFORMANCE OF AN ANTI-COMPTON GAMMA RAY SPECTROMETER.

J.S.Rosen, J.C.Whiton, and C.W.Hill.

IRE Trans nuclear Sci. (USA), Vol. NS-8, No. 2, 4-12 (April, 19

The spectrometer consists of a small cylindrical crystal surrounded by a larger, hollow cylindrical crystal, both compose of NaI:Tl. The results of a two-parameter study-incident gamm ray energy and relative crystal positions are given.

9742 A PHOTON COUNTER WITH A CONTROL GRID. S.M.Perel'man, V.I.Malinin and N.M.Shyutte.

Pribory i Tekh. Eksper. (USSR), 1959, No. 6, 95-7 (Nov.-Dec.). In Russian.

Describes the development of a commercial gas-filled count for the range about 2500-3300 A. The long wave limit is determ by the (Pt or W) photocathode and the shortwave limit by unwante emission from the control grid (oxidised Mo). [English translati in: Instrum. exper. Tech. (USA) No. 6, 952-5 (Nov.-Dec., 1959; publ. Sept., 1960)]. G.F.Loth

9743 MAGNETOCHEMICAL DOSIMETRY OF γ-RAYS. S.Yamaguchi, H.Takeshita and R.Otsuka.

Naturwissenschaften (Germany), Vol. 47, No. 8, 176 (1960). In German.

Irradiation of ferrous ammonium sulphate solution with γ-ra from Co^{60} produces Fe_3O_4 which is ferromagnetic. A graph of amount of Fe_3O_4 produced with time of irradiation shows that thi effect might be used as a crude magnetochemical dosemeter. J.R.Mal

9744 INVESTIGATION OF BREMSSTRAHLUNG AND PAIR PRODUCTION AT ENERGIES $>10^{11}$ eV. E.Lohrmann.
. Rev. (USA), Vol. 122, No. 6, 1908-17 (June 15, 1961).
Pair production and bremsstrahlung at energies >100 BeV were
stigated in nuclear emulsions by studying 91 primary electron--
ron pairs starting high-energy cascades and the first secondary
. The average energy of the showers was 320 BeV. The experi-
al results on the total number and the energy spectrum of
ons radiated by electrons $>\sim$ 100 BeV show a lack of soft
ons, which is in disagreement with the Bethe—Heitler theory.
experiment agrees well with the new theory given by Landau,
eranchuk, Migdal, and Ter-Mikaeljan. A method for obtaining
nean free path L for direct pair production is presented which
ds the use of a correction for spurious tridents. A value
12_{-4}^{+7} cm is obtained for an average electron energy of about
BeV. The conversion length of photons of average energy 320
in nuclear emulsion is 34 ± 5 mm, in agreement with the theo-
al value of 37 mm. The distribution of the separation between
lectron and the positron of the original high-energy pair is also
greement with the theoretical distribution. This indicates that
ppreciable discrepancy can exist between experiment and the
retical cross-section for the energy partition between an
tron and a positron, and the probability of large energy losses
adiation. Several high-energy showers presumably produced
-mesons and one possible case of a double pair production are
ribed.

745 IMPROVED MEASUREMENT OF THE X-RAY BREMSSTRAHLUNG SPECTRA FROM THIN ANTI-
HODES AT 34 keV. H.Kulenkampff and D.Röss.
hys. (Germany), Vol. 161, No. 4, 424-7 (1961). In German.
Previous measurements of the continuous X-ray spectrum
tr. 6216, 8831 of 1955) were repeated with improved apparatus.
results show that the earlier work is in need of correction.
general nature of these corrections is indicated.
A.E.I. Research Laboratory

746 POLARISATION OF THE X-RAY BREMSSTRAHLUNG FROM THIN ANTICATHODES AT 35 and 45 keV.
ılenkampff and W.Zinn.
hys. (Germany), Vol. 161, No. 4, 428-38 (1961). In German.
Use is made of improved apparatus to repeat earlier
surements of the degree of polarization of bremsstrahlung
lms of Al_2O_3 at 35 and 45 keV and gold films at 35 keV.
surements were made with a proportional counter in the
ction at right angles to the beam. The new measurements
irm the general correctness of previous measurements by
uthors and at the same time demonstrate greater precision.
mparison with available theory is satisfactory; slight
repancies that arise can easily be accounted for by approxima-
made in the theory. A.E.I. Research Laboratory

ectrons

9747 RADIATIVE CORRECTIONS TO ELECTRON-ELECTRON AND ELECTRON-POSITRON SCATTERING.
ırlan and G.Peressutti.
o Cimento (Italy), Vol. 19, No. 4, 830-4 (Feb. 16, 1961).
Radiative corrections to order e^4 both for Møller and Bhabha
tering are given. The contributions of the inelastic parts
msstrahlung) are computed only for the particular case of
opic soft photon emission. The vertex part dominates the
ections to Møller scattering. The two photon exchange graphs
the principal corrections to Bhabha scattering. Numerical
on the cross-sections are given. T.Erber

9748 RADIATIVE CORRECTIONS TO ELECTRON—PROTON SCATTERING. Y.S.Tsai.
. Rev. (USA), Vol. 122, No. 6, 1898-1907 (June 15, 1961).
The radiative corrections are calculated with the effects of the
on recoil taken into account. The experimental conditions of
tadter et al. at Stanford are assumed (Abstr. 2039, 3178 of
), namely only the final electrons are momentum-analysed.
anisotropy in the maximum energy of photons which can be
ed and the radiation from the proton current are the two main
ts due to the proton recoil, and both effects are considered.
mesonic effects in the two-photon exchange diagrams are not
idered. Other than the uncertainty in the mesonic effects, this
ula is good up to about 5 BeV.

9749 DETERMINATION OF THE MAXIMUM ENERGY OF β RADIATION BY THE MEASUREMENT OF THE HALF-THICKNESS OF ACTUAL ABSORPTION.
L.Danguy, J.Franeau and A.Lhost.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 9, 774-90 (1960).
In French.

The experimental study of actual β-absorption shows that, in the energy region investigated by the authors, 0.171 to 1.701 MeV, the absorption is independent of the nature of the absorbants if: (a) their thickness is expressed in mg/cm^2; (b) the absorbants are sufficiently thin; and (c) the solid angle of the incident radiation is small. Under these conditions, the half-thickness of actual absorption, $X_{1/2}$, is proportional to the energy E_{max} of the β-radiation and the relationship exists: E_{max} (MeV) = 0.0143 $X_{1/2}$ (mg/cm^2).
B.Brown

MONOENERGETIC POSITRONS. See Abstr. 9832

PAIR PRODUCTION AT ENERGIES $>10^{11}$ eV. See Abstr. 9744

INFLUENCE OF A STATIC ELECTRIC FIELD ON POSITRONIUM FORMATION IN POLYMERS. See Abstr. 8901

Nucleons

9750 ON A MODEL OF NUCLEON STRUCTURE AND MESON—NUCLEON INTERACTION. I. H.Nakamura.
Progr. theor. Phys. (Japan), Vol. 24, No. 2, 271-90 (Aug., 1960).

The problems of π—nucleon collision and nucleon—antinucleon annihilation are treated using a phenomenological model in which one assumes the existence of a repulsive core for the nucleon—nucleon potential and an attractive core for the nucleon—antinucleon potential. The results give rather good agreement with experimental evidence on π—nucleon collisions and nucleon—antinucleon annihilation.

9751 ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. V. NUMERICAL RESULTS OF THREE-PION-STATE CONTRIBUTIONS. K.Hiida and N.Nakanishi.
Progr. theor. Phys. (Japan), Vol. 24, No. 2, 414-17 (Aug., 1960).

For Pt IV see Abstr. 3177 of 1961. Numerical results of the 3π-state contributions to the isoscalar part of the electromagnetic structure of the nucleon are presented in the no-loop approximation of relativistic perturbation theory. They are compared with the previous results obtained on other approximations. [An additional graph for this paper is published as an erratum in ibid., Vol. 24, No. 3, 688 (Sept., 1960)].

NON-LOCAL PROPERTIES OF THE SECOND-ORDER TWO-NUCLEON INTERACTION. See Abstr. 9733

9752 INVALIDITY OF THE RAPHAEL ANALYSIS FOR MODERATE ENERGY NN SCATTERING.
P.Signell and R.Yoder.
Phys. Rev. (USA), Vol. 122, No. 6, 1897 (June 15, 1961).

Raphael's modified effective-range expansion for nucleon—nucleon scattering (Abstr. 4205 of 1956) is usually truncated at the second term. It is explicitly shown that the resulting series is not a good representation of the predictions of reasonable potential models for moderate-energy nucleon—nucleon scattering. In particular, it can lead to the wrong sign for the shape parameter.

Protons

9753 INFORMATION ABOUT THE PROTON—PROTON SCATTERING MATRIX FROM COULOMB INTERFERENCE. B.P.Nigam.
Progr. theor. Phys. (Japan), Vol. 24, No. 2, 407-13 (Aug., 1960).

It is shown that a measurement of the p—p scattering parameters at very small angles and angles close to π where Coulomb interference is important will directly determine the coefficients of the scattering matrix. Since the coefficients are known functions of the phase shifts, such measurements may rule out some of the phase shift solutions and may provide a unique set of phase shifts.

9754 POLARIZATION OF $\bar{p}$ IN $\bar{p}$ C SCATTERING.
P.K.Srivastava.

Nuovo Cimento (Italy), Vol. 20, No. 1, 172-4 (April 1, 1961).

Optical model parameters for $\bar{p}$ C scattering are estimated assuming that the nucleon—nucleon spin—orbit force is due to exchange of a vector meson, (or 3 pion resonance), with T = O. At 160 MeV/c an average polarization of 11.4% is predicted. For $\bar{p}p$ scattering at 16 BeV/c the figure is 39%. D.W.L.Sprung

Mesons

9755 A NOTE CONCERNING THE MAGNETIC MOMENT OF THE MUON. N.Byers and F.Zachariasen.

Nuovo Cimento (Italy), Vol. 18, No. 6, 1289-90 (Dec. 16, 1960).

A calculation is reported of the effect on the magnetic moment of the muon due to a vector boson intermediary for weak interactions. It is found that if the neutrinos in β- and μ-decay are identical, then the anomalous moment (μ_χ) due to such a boson is less than 3×10^{-10} e/2m$_\mu$, where m$_\mu$ is the mass of the muon. If the two neutrinos are not identical then $\mu_\chi \cong 10^{-9}$ e/2m$_\mu$.

A.M.Green

THE RANGE—ENERGY RELATION FOR HIGH ENERGY μ-MESONS. See Abstr. 9792

9756 ON THE $e^+ + e^- \rightarrow \pi^0 + \gamma$ PROCESS.
G.Furlan.

Nuovo Cimento (Italy), Vol. 19, No. 4, 840-3 (Feb. 16, 1961).

The structures of the matrix element and cross-section for the process $e^+ + e^- \rightarrow \pi^0 + \gamma$ are examined and the imaginary part of the scattering amplitude is written down from the usual dispersion relation. Limiting himself to the two-pion state the author claims that the scattering amplitude depends practically on three quantities: the position and width of the resonance which characterizes the Frazer and Fulco pion form factor and on the coupling constant (i.e. on the π^0 meson mean life assuming $\gamma + \pi \rightarrow \pi + \pi$ dominant in $\pi^0 \rightarrow 2\gamma$ decay). J.H.Gunn

9757 PRODUCTION OF PION PAIRS — ISOSPIN ANALYSIS. P.Carruthers.

Phys. Rev. (USA), Vol. 122, No. 6, 1949-53 (June 15, 1961).

The reactions $\gamma + N \rightarrow 2\pi + N$ and $\pi + N \rightarrow 2\pi + N$ are analysed in terms of the relevant isospin amplitudes. An experiment is suggested to measure the phase difference between even and odd π—π isospin states, with a view toward detecting a resonance in the π—π system. The experimental determination of the magnitude and phase of the amplitudes for the second reaction is discussed.

ANALYTIC PROPERTIES OF $\pi + N \rightarrow \pi + \pi + N$ AMPLITUDES. See Abstr. 9736

9758 MEASUREMENTS ON THE π^-—He CROSS SECTIONS AT HIGH ENERGY.

G.Brautti, L.Chersovani, C.Franzinetti, M.Sedmak-Furlan and R.Tosi-Torelli.

Nuovo Cimento (Italy), Vol. 19, No. 6, 1270-4 (March 16, 1961).

Interactions with helium nuclei of π^--mesons of 0.97, 1.67 and 2.26 GeV were studied in a liquid helium chamber. Results are presented, based on about 1400 events at each of the lower energies and 817 at the higher, for the total cross-section, the elastic scattering differential cross-section, and the cross-sections for strange particle production. S.J.Goldsack

9759 EFFECTS OF THE γ—3π INTERACTION ON PHOTOREACTIONS.

M.Kawaguchi, Y.Miyamoto and Y.Fujii.

Nuovo Cimento (Italy), Vol. 20, No. 2, 408-12 (April 16, 1961).

If the γ—3π interaction is responsible for the isoscalar part of the electromagnetic form factors of the nucleus; the authors claim that it is also important for pion photoproduction, the magnetic moment of the deuteron, and photodisintegration of the deuteron. Discussion is focused on obtaining information about the sign and magnitude of the coupling constant for the above processes.

J.H.Gunn

9760 INELASTIC π^--NUCLEON INTERACTIONS AT 7.5 GeV.
L.C.Grote, U.Krecker, U.Kundt, K.Lanius, G.Manske and H.W.Meier.

Nuclear Phys. (Internat.), Vol. 24, No. 2, 300-12 (April, 1961).

In a stack of NIKFI-R emulsions, which was irradiated at Dubna with negative pions, 111 inelastic π^--nucleon collisions were identified. The angular distribution of the emitted particles, their momenta and transverse momenta were investigated and compared with the results of Beljakov et al. Discussion of the results shows that the interactions can be partly ascribed to pion—pion collisions. For those collisions, the radius of the interaction volume could be estimated to be $\Delta r_{\pi\pi} \gtrsim 1.0 \times 10^{-13}$ cm. For the remainder of the pion—nucleon collisions $\Delta r_{\pi N} \gtrsim 0.4 \times 10^{-13}$ cm.

9761 PION—HYPERON RESONANCES IN PION PRODUCTION IN HYPERON—NUCLEON COLLISIONS.

S.N.Biswas and V.Gupta.

Nuclear Phys. (Internat.), Vol. 24, No. 4, 620-9 (May, 1961).

A brief survey of the one-pion production phenomena in hyperon—nucleon collisions is presented. Equalities and inequalities among the cross-sections for the various pion production reactions, based on the hypothesis of charge-independence, are given. The effect of the resonances of the pion—nucleon and pion—hyperon systems in the final state is considered. The modification of these results due to the restricted symmetry hypothesis is also pointed out. Finally, the possibility of ascertaining the relative Σ—Λ parity from the angular distribution is indicated.

9762 THE EFFECT OF π^2 TERM IN THE S-WAVE π-N SCATTERING. I.Umemura.

Progr. Theor. Phys. (Japan), Vol. 23, No. 6, 1216-18 (June, 1960).

An expression for the S-wave, isotopic state I, phase shift δ_I is derived using the approximation methods of Lomon, and of Kobayashi and Klein. The momentum dependence of $|\delta_{3/2}|/\delta_{1/2}$ is compared with the case of no π^2 term, and the agreement with experiment, though still not good, is improved. I.J.R.Aitchison

9763 RECOIL PROTON POLARIZATION IN π^-—p ELASTIC SCATTERING AT 600 MeV.

P.Franzini and J.M.Gaillard.

Nuovo Cimento (Italy), Vol. 19, No. 5, 1062-4 (March 1, 1961).

The use of measurements of the angular distribution of the recoil proton polarization in π^-—p elastic scattering to remove the ambiguity in phase-shift analyses of the differential cross-sections is discussed. The polarization angular distributions are calculated for three alternative sets of phase shifts consistent with the 600 MeV elastic differential cross-section. It is suggested that it might be possible to distinguish between these experimentally.

R.F.Peierls

CHARGE-CONJUGATION CORRELATIONS OF THETA-PARTICLES. See Abstr. 9322

9764 MEASUREMENTS OF THE BRANCHING RATIOS OF K^0 AND Λ^0. C.Baglin, M.Bloch, V.Brisson,

J.Hennessy, A.Lagarrigue, W.Mittner, P.Musset, A.Orkin-Lecourtois, P.Rançon, A.Rousset, A.M.Saruis, X.Sauteron and J.Six.

Nuovo Cimento (Italy), Vol. 18, No. 5, 1043-4 (Dec. 1, 1960).

Reports a measurement of the branching ratios

$$B_K = \frac{\omega(K_1^0 \rightarrow \pi^0 + \pi^0)}{\omega(K_1^0 \rightarrow \pi^0 + \pi^0) + \omega(K_1^0 \rightarrow \pi^+ + \pi^-)}$$

and

$$B_\Lambda = \frac{\omega(\Lambda^0 \rightarrow n + \pi^0)}{\omega(\Lambda^0 \rightarrow n + \pi^0) + \omega(\Lambda^0 \rightarrow p + \pi^-)}$$

using a (34 × 24 × 20) cm bubble chamber containing 50% by volume of propane and 50% of methyl iodide. 100 000 photographs were taken in a 1.12 GeV/c negative pion beam from the "Saturne" synchrotron at Saclay and the reactions analysed were

$$\pi^- + p \rightarrow \Lambda^0 + K^0$$
$$\pi^- + p \rightarrow \Sigma^0 + K^0.$$

A total of 23 events gives the following ratios:

$$B_K = 0.26 \pm 0.06$$

$$B_\Lambda = 0.28 \pm 0.08$$

ich are in agreement with previous results and with lower limit
edictions from decay rules. J.D.Dowell

9765 NATURE OF THE $K^+ + n \to K^0 + p$ ANGULAR DISTRIBUTION. E.Helmy, D.J.Prowse and D.H.Stork.

ovo Cimento (Italy), Vol. 19, No. 1, 179-82 (Jan. 1, 1961).
An account of a redetermination of the gross features of the
–n charge exchange angular distribution at 260 MeV in nuclear
ulsion. The distribution is found to be peaked in the forward
ection, and is in agreement with the forward–backward charged
change ratio predicted by the T = O K^+–nucleon phase-shift
utions of Melkanoff, Prowse, Stork and Ticho (Abstr. 17417
1960) which give an attractive p-wave interaction.
J.D.Dowell

9766 $\bar{K}$–NUCLEON BOUND STATE INTERPRETATION OF THE 1385 MeV π–Λ RESONANCE. R.H.Dalitz.

ys. Rev. Letters (USA), Vol. 6, No. 5, 239-41 (March 1, 1961).
A zero-range approximation to the scattering in the coupled
n–hyperon and K–nucleon channels leads to an explicit description
the π–Λ resonance at 1385 MeV as due to a bound state of the
-nucleon system. The parameters of such a theory are compared
h the experimental results on the width, branching ratios, etc.
R.F.Peierls

9767 K–π RESONANCE AND LIFETIME OF THE K' PARTICLE. M.A.Baqi Bég and P.C.DeCelles.

ys. Rev. Letters (USA), Vol. 6, No. 8, 428 (April 15, 1961).
A numerical error in a previous letter (Abstr. 5776 of 1961)
verses the tentative identification of the spin of the K–π reson-
ce. The K_V alternative is now preferred. J.S.Dowker

yperons

9768 SOME TESTS FOR COMPOUND MODELS OF ELEMENTARY PARTICLES.

Bhamathi, S.Indumathi, A.P.Balachandran and N.G.Deshpande.
ovo Cimento (Italy), Vol. 19, No. 1, 190-2 (Jan. 1, 1961).
Predictions of asymmetry parameters for the decay of hyperons
ve already been made on the assumption that they are bound
tes of other particles. This model also predicts a relation
tween scattering phase shifts of the constituent particles and the
ding energy; this relation is satisfied if Σ is regarded as a
und state of Λ and π, but not if it is regarded as a bound state of
and N. Selection rules for the annihilation of K-mesons are
duced. D.J.Thouless

NON-LEPTONIC DECAYS OF HYPERONS. See Abstr. 9730

9769 THE HYPERON AND NUCLEON INTERACTIONS. I. POTENTIALS. M.Uehara.

ogr. theor. Phys. (Japan), Vol. 24, No. 3, 629-47 (Sept., 1960).
Two- and three-body Y–N potentials including the rescattering
rrections are calculated by using Miyazawa's method (Abstr.
73 of 1957). The Y–N systems are treated by the two-channel
malism in the case of $T = \frac{1}{2}$: the one is the channel of the Σ–N
stem and the other is of the Λ–N system. The potential is then
ined as the 2 ×2 matrix form. The three-body force vanishes, in
ich no direct two-nucleon interaction is considered, if the π–Λ
scattering corrections are not taken into account. The other type
the three-body force in which one pion is exchanged between each
r of the particles is also investigated.

9770 $\Lambda\Pi$ RESONANCE AND POSSIBLE DETERMINATION OF THE KYN PARITIES. M.Ross and G.Shaw.

ys. Rev. Letters (USA), Vol. 5, No. 12, 578-80 (Dec. 15, 1960).
The $\Lambda\Pi$ resonance discovered by Alston et al. (Abstr. 3240 of
1) is described in terms of a quasi-bound state of the isotopic
n I = 1, s-wave KN system. Tests of this hypothesis are
posed, and it is pointed out that if it is correct, the determination
he orbital angular momentum of the resonant $\Lambda\pi$ state (or the
onant $\Sigma\pi$ state which should also occur) will establish the
responding relative parities of the K-meson and the hyperon.
P.K.Kabir

Y* PARTICLES: GLOBAL SYMMETRY CONSIDERATIONS. See Abstr. 9729

9771 A SEARCH FOR THE DECAY $\Sigma^+ \to p + \gamma$. R.G.Glasser, N.Seeman, Y.Prakash, G.A.Snow and P.Steinberg.

Nuovo Cimento (Italy), Vol. 19, No. 5, 1058 (March 1, 1961).

No case of such a decay was found among the products of some 16 000 K^-stars, which produced 144 events consistent with $\Sigma^+ \to p + \pi^0$. S.J.Goldsack

9772 ABSORPTIONS IN FLIGHT OF Σ^- HYPERONS IN EMULSION NUCLEI.

B.D.Jones, B.Sanjeevaiah, J.Zakrzewski and D.H.Davis.

Nuovo Cimento (Italy), Vol. 19, No. 2, 400-3 (Jan. 16, 1961).

Descriptions are given of two secondary stars, due to particles emitted during the capture of K^- mesons in photographic emulsion, which are identified as due to the interaction in flight of Σ^- hyperons. It is pointed out that such events must frequently escape detection: these two cases were identified because, in one a hyperfragment was emitted, and in the other the interaction could be shown to be exothermic. S.J.Goldsack

9773 THE COULOMB SCATTERING OF NEUTRAL HYPERONS AND THE LIFETIME OF THE Σ^0.

W.S.C.Williams.

Nuovo Cimento (Italy), Vol. 19, No. 6, 1278-9 (March 16, 1961).

The inverse of the Σ^0 decay induced by Coulomb scattering of Λ's might be observed in a hydrogen cloud chamber if the Λ's are produced below the Σ^0 threshold. J.E.Paton

9774 ON A MODEL FOR Ξ DECAYS. A.P.Balachandran and N.R.Ranganathan.

Nuovo Cimento (Italy), Vol. 18, No. 6, 1269-70 (Dec. 16, 1960).

The Ξ is treated as a bound Λ^0 $\bar{K}$ system, the decay proceeding by decay of the Λ^0 to N and π and the subsequent absorption $\bar{K} + N \to Y$. The asymmetry parameters for Λ^0 and Ξdecay are found to be equal. J.S.Dowker

Deuterons

9775 (D–D) REACTION PRODUCT VELOCITIES IN SCEPTRE III ACCORDING TO A TWO-GROUP MODEL.

R.Herdan and T.P.Hughes.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 987-96 (May, 1961).

The relation is given between the drift velocity Δ of a hot group of deuterons, mixing with a cooler stationary group, and the mean centre-of-mass velocity $\langle W\rangle$ of reacting deuteron pairs. Subject to certain restrictions on temperatures and densities, $\langle W\rangle/\Delta$ can be as high as 3 or more. It is suggested that departures from the Maxwellian distribution may make the ratio large enough to explain results obtained with Sceptre III, without invoking any acceleration other than that due to the applied electric field.

9776 TEST OF ISOTOPIC SPIN CONSERVATION FROM AN EXPERIMENT LIMIT ON $\sigma(d + d \to He^4 + \pi^0)$.

J.A.Poirier and M.Pripstein.

Phys. Rev. (USA), Vol. 122, No. 6, 1917-18 (June 15, 1961).

The reaction $d + d \to He^4 + \pi^0$, which is forbidden by isotopic spin conservation, has been looked for at the Berkeley 184 in. cyclotron. A beam of deuterons of 460 MeV kinetic energy was scattered from an extended target filled with deuterium gas at 25 atm pressure and at liquid-nitrogen temperature. The differential cross-section in the centre-of-mass system at $\theta_{c.m.} = 90$ deg was measured and a value of $(18 \pm 2.3) \times 10^{-34}$ cm^2/sr was obtained. This value is considered to be an upper limit for the reaction; the data are consistent with no π^0 production. From a comparison of this upper limit with the theoretical prediction of the cross-section for this reaction if isotopic spin need not be conserved, it is concluded that isotopic spin is at least 93.5% conserved.

9777 THEORY OF CONSERVATION OF ISOTOPIC SPIN FROM d + d REACTIONS. K.R.Greider.

Phys. Rev. (USA), Vol. 122, No. 6, 1919-20 (June 15, 1961).

The theoretical cross-section for the reaction $d + d \to He^4 + \pi^0$ is calculated in the impulse approximation. It is assumed that the matrix element contains no isospin dependence which, due to conservation laws, would ordinarily prohibit pion production. The comparison of the theoretical and experimental cross-sections for the reaction yields an upper limit of 6.5% for the amount of isospin nonconservation in strong interactions. A discussion of the effects of different He^4 wave-functions in the calculations is also included.

9778 PHOTODISINTEGRATION OF THE DEUTERON AT HIGH ENERGIES. T.Akiba.
Progr. theor. Phys. (Japan), Vol. 24, No. 2, 370-85 (Aug., 1960).

Exchange current effects in the photodisintegration of the deuteron at high energies are discussed. Special consideration is given to (1) correlation of the exchange effects with the large direct E1 transition; (2) consequences of gauge invariance for the electric transitions due to exchange effects; (3) evaluation of the magnetic transition caused by the (33)-resonance in terms of the results of the Chew—Low theory. It is shown that exchange effects affect the electric dipole transition operator in a way consistent with the Siegert theorem. The resulting change in the electric dipole cross-section is evaluated in the adiabatic approximation as well as in neglect of higher-order retardation effects. It is appreciable only at photon energies above the pion threshold. Some characteristics of the (33)-resonance effect are revealed, although nucleon-recoil effects and uncertainty of nuclear force make it difficult to give any quantitative estimation. The results obtained are compared with experiment.

Alpha-particles

9779 INTERACTION OF NEUTRONS WITH HE^3.
A.R.Sayres, K.W.Jones and C.S.Wu.
Phys. Rev. (USA), Vol. 122, No. 6, 1853-63 (June 15, 1961).

Spectra of the n + He^3 reactions were obtained for monoenergetic neutron fluxes of 0.95, 2.67, 5.00, 8.07, and 17.5 MeV using a He^3-filled proportional counter. Analysis of these spectra yielded the ratios to the total cross-section of the total elastic, the $He^3(n, p)He^3$, and the $He^3(n, d)D$ reaction cross-sections. Absolute cross-sections were obtained by normalization to the known total cross-section. Differential elastic-scattering cross-sections for neutrons on He^3 were obtained through the relationship between the scattering angle of the neutron and the observed energy of the He^3 recoil in the counter filling. These angular distributions are compared with the theoretical angular distributions as calculated by Bransden, Robertson, and Swan (Abstr. 2678 of 1956). The present experiment was intended to discriminate between their assumed two special cases for the potential interaction, the symmetrical exchange force and the Serber exchange force. The experimental results favour the Serber exchange force. This experiment also was intended to make possible the analysis of more complex neutron spectra by providing knowledge of n + He^3 reaction cross-sections and the spectra obtained when only monoenergetic neutrons are present. A comparison is made of the results of this experiment with cross-sections calculated from inverse reactions and direct measurements of other investigators, where such data are available.

9780 THE MEAN FREE PATH FOR α-PARTICLES IN NUCLEAR PHOTOGRAPHIC EMULSION.
R.L.English.
Nuovo Cimento (Italy), Vol. 19, No. 6, 1269 (March 16, 1961).

The best estimate obtained for the mean free path of α-particles at intermediate energies, around 600 MeV/nucleon, is $\lambda = (19.2 \pm 0.4)$ cm. S.J.St-Lorant

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COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

9781 ORIGIN OF COSMIC RAYS.
J.N.Tandon.
Nature (GB), Vol. 190, 246-7 (April 15, 1961).

Advances the hypothesis that cosmic rays originate from M-dwarf emission stars. In the solar flare of February 23, 1956, particles with energy in the range 10^9 to 2.4×10^{10} eV were observed and the total energy of the flare exceeded 10^{32} ergs. This particle energy exceeds the minimal injection energy required by Fermi's theory of acceleration of cosmic rays in interstellar magnetic fields (Abstr. 3291 of 1949). Making the plausible assumptions that all red emission dwarfs are flare stars with a flare energy exceeding 3×10^{35} ergs, that flares occur on the average once in a year, and that 10% of the M-dwarf stars are emission stars, it is concluded that the release of energy will be 1.5×10^{38} ergs/sec. This is comparable with Shklovsky's figure of 10^{39} ergs/sec lost in the Galaxy as the result of nuclear collisions with interstellar gas [Cosmic Radio Waves, Cambridge, Massachusetts: Harvard University Press (1960), p. 334], thus suggesting that the emission from red dwarfs will supply sufficient energy to maintain dynamical equilibrium of cosmic rays in our Galaxy. J.L.Redding

SPALLATION OF INTERSTELLAR MATTER: COSMIC-RAY INTENSITY IN THE PAST. See Abstr. 9251

9782 ON EXTRAGALACTIC COSMIC RAYS.
H.Kasha.
Bull. Res. Coun. Israel, Vol. 9C, No. 1-2, 120 (Feb., 1961).

An abstract, with some references, of a review article on the evidence for extragalactic primaries of energy greater than 10^{17} eV. N.A.Porter

9783 THE FLUX OF PRIMARY COSMIC RAY α-PARTICLES OVER SOUTHERN ENGLAND. A.Mason.
Nuovo Cimento (Italy), Vol. 18, No. 5, 1037-8 (Dec. 1, 1960).

Measurements were made in a G5 emulsion stack exposed in November 1958 at geomagnetic latitude 55°N, and pressure altitude 20.7 g/cm^2. Extrapolating to the top of the atmosphere, the flux of α-particles is found to be 121 ± 15 particles/m^2.sr. sec, lower than that found in earlier flights at sunspot minimum. It is concluded that the flux in 1958 was still at the value for sunspot maximum. Using a previously determined energy spectrum and cut-off energy, the flux expected was (107 ± 19) particles/m^2. sr. sec, at sunspot maximum. N.A.Porter

9784 ON A CONSEQUENCE OF THE TWO-CENTRE MODEL OF COSMIC RAY JETS. E.M.Friedländer.
Nuovo Cimento (Italy), Vol. 19, No. 4, 818-20 (Feb. 16, 1961).

Using a nucleon—nucleon collision model described previously, (Abstr. 20269 of 1960) with experimental observations on 62 jets, it is shown that the average value for the target mass in a collision is 1.13 ± 0.13 pion masses. This is interpreted as showing that one pion in the meson cloud of each of the colliding nucleons, takes part in the collision, and that the pions have low kinetic energy. N.A.Porter

9785 VARIATIONS IN SOLAR TIME OF EXTENSIVE AIR SHOWERS.
B.G.Wilson, J.G.G.Dionne and F.Terentiuk.
Canad. J. Phys., Vol. 39, No. 6, 935-40 (June, 1961).

150 000 extensive air showers of high electron density were recorded at an altitude of 2283 m. Analysis of the data in solar time for a wide range of densities shows no evidence for the large semidiurnal variations previously reported by other groups. A possible explanation of this difference may lie in the different methods of selecting the showers.

9786 CASCADE THEORY OF SHOWERS.
S.Z.Belen'kii and I.P.Ivanenko.
Uspekhi Fiz. Nauk (USSR), Vol. 69, No. 4, 591-656 (Dec., 1959). In Russian.

Review of unidimensional electron—photon cascade theory, covering work up to 1958 by Soviet and other authors. Some previously unpublished results are given in tabulated and graphical form

number and energy spectra as a function of absorber thickness, light and heavy elements, for primary energies up to 3 × 10^{15} eV. sults are also presented for sub-critical electrons, with some perimental comparisons. The value and applicability of different eoretical methods are discussed. [English translation in: Soviet ysics—Uspekhi (USA), Vol. 2, No. 6, 912-57 (June, 1960)].
N.A.Porter

9787 A NOTE ON ELECTRON PHOTON SHOWERS.
A.Ramakrishnan and S.K.Srinivasan.
clear Phys (Internat.), Vol. 25, No. 1, 152-4 (May, 1961).

The mean square deviation of the number of electrons obtained Butcher and Messel (Abstr. 20264 of 1960) is compared with the rlier results based on exact methods of stochastic theory; the gree of validity of Monte Carlo methods for such processes is scussed.

9788 THE COSMIC RAY FLARE ON NOVEMBER 12, 1960, AND SOLAR ACTIVITY DURING THE PERIOD NOVEMBER -15, 1960.
ture (GB), Vol. 189, 438-40 (Feb. 11, 1961).

The position and importance of the optical flares and the quency, duration and energy of their associated radio responses given. An unusually strong outburst of radiation at 2980 Mc/s gan at 1322 (U.T.) on Nov. 12, achieving an integrated flux nsity of 34 × 10^{-16} W.m.$^{-2}$(c/s)$^{-1}$ min. The flares of Nov. 11 d 14 were followed about 34 hours later by sudden geomagnetic rm commencements. The flares of Nov. 12 and 15 were followed out 20 hours later by a sudden impulse and a reinforcement of omagnetic activity, respectively, of world wide character. The ensity of the low energy part of the cosmic radiation at geo-gnetic latitude 53.9°, increased by 56% on Nov. 12, 1930 (U.T.) d coincided with a strong increase in geomagnetic activity. The smic-ray intensity increased by 15% on Nov. 15. Both cosmic- flares were followed by exceptionally large solar-flare effects earth potential measurements near the equator. J.L.Redding

9789 MEASUREMENTS OF COSMIC RADIATION FOLLOWING THE SOLAR FLARE OF MAY 4, 1960.
Trumpy and T.Svanes.
ook Univ. Bergen mat.-nat. Ser (Norway), 1960, Paper 16, 9 pp.

Results obtained at Bergen are given for the nuclear com-ent, the total radiation and the meson component. The results compared with corresponding results from a Swedish station d some USA stations regarding the size of the increase and the e of its appearance.

9790 ON THE HIGH ENERGY SOFT COMPONENT NEAR SEA LEVEL. T.Kameda.
Phys. Soc. Japan, Vol. 15, No. 7, 1175-85 (July, 1960).

Using an experimental arrangement consisting of GM-counter loscopes and an ionization chamber with large area, the pulse ght distribution of cosmic-ray showers produced by electrons or otons in lead and iron absorbers of different thickness was asured. The number of shower particles was estimated from the se height considering the angular spread of shower particles, and energy of electrons or photons was obtained from the results shower theory. The results of the present experiment show that, the differential energy spectra can be represented by a power of the form $E^{-\gamma}$, with γ of 2.90 and 2.80 for electrons and otons of 2—20 BeV, respectively, (ii) the zenith angle distribution electrons is expressed by $\cos^2\theta$, and (iii) upper limit of the ratio the number of electrons to that of photons is 1.1. It is also found t the calculated results of Ivanenko (1959) explain the observed sults for lead and iron absorbers. The essential part of this estigation is to provide a classification of the incident electrons photons by the GM-counter hodoscopes, that is, single incident ticles, multiple incident ones, and those associated with EAS separated in order to minimize the ambiguity involved in the sults.

9791 POLARIZATION OF COSMIC-RAY MUONS AT SEA LEVEL. C.S.Johnson.
ys. Rev. (USA), Vol. 122, No. 6, 1883-90 (June 15, 1961).

Cosmic-ray muons at sea level are known to be partially gitudinally polarized. The object of this experiment was to mea-e the positive muon polarization by stopping the muons in a pper absorber and observing the up:down asymmetry in the decay ctrons. Measurements were also made with iron and sulphur as trol absorbers to test the symmetry of the apparatus. Since s experiment was performed in zero magnetic field, it was possible to verify that unmagnetized iron depolarizes positive muons by precessing their magnetic moments in the strong, randomly oriented magnetic fields of the domains. The up:down ratio of decay electrons was 1.14 ± 0.02 for copper, 0.98 ± 0.02 for iron, and 1.02 ± 0.03 for sulphur. On the basis of the two-component neutrino theory, the muon polarization is found to be ≥(21 ± 3)%, where the inequality is due to depolarization effects. On the basis of cosmic-ray data on the muon energy spectrum as a function of altitude, the polarization is expected to be about 30%. The data of the present experiment suggest that in the absence of external magnetic fields copper depolarizes positive muons, as there appears to be a decrease in the up:down ratio with time lived before decay.

9792 THE RANGE—ENERGY RELATION FOR HIGH ENERGY μ-MESONS. F.Ashton.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 587-92 (March, 1961).

The range—energy relation for μ-mesons with energies up to 1000 GeV was studied by comparing the sea-level energy spectrum of cosmic rays with the underground depth—intensity curve. No significant divergence from accepted theory was found.

9793 THEORETICAL CALCULATION OF THE SOLAR DIURNAL VARIATION OF THE COSMIC RAY INTENSITY. K.Nagashima, V.R.Potnis and M.A.Pomerantz.
Nuovo Cimento (Italy), Vol. 19, No. 2, 292-330 (Jan. 16, 1961).

The variation of the nucleonic component at sea level is calculated assuming an anisotropy originating (a) outside the earth's magnetic field, (b) inside the earth's field. The anisotropy Δf is described by three parameters; P, the rigidity, and m and n, which determine the rigidity dependence and directional dependence of Δf. A threshold value of P is defined. Values of the parameters may be chosen either from a model, or by comparison with observation. The local time of maximum intensity shows a dependence on geomagnetic longitude for both terrestrial and extra-terrestrial models of the origin of Δf. At latitudes higher than 50°, the amplitude shows longitude dependence only for extra-terrestrial origin. Lower than 50° there is no significant difference between the diurnal variations predicted for both models. Altitude correction factors are also presented. These are nearly independent of geomagnetic longitude.
N.A.Porter

9794 SOLAR-PRODUCED COSMIC RAYS NEAR THE NORTH AND SOUTH POLES.
M.A.Pomerantz, S.P.Duggal and K.Nagashima.
Phys. Rev. Letters (USA), Vol. 6, No. 3, 123-5 (Feb. 1, 1961).

The solar flares of Nov. 12 and Nov. 15, 1960, both caused increases in neutron intensity at Thule, near the North geomagnetic pole, and at McMurdo, near the South geomagnetic pole. At the Northern station, the Nov. 12 flare produced a double humped maximum, amplitude 103% at 1608 U.T., and 135% at 1958 U.T. The Southern station had a single maximum of 118% at 1624-1640 U.T. The Nov. 15 flare produced simultaneous maxima of 83% and 85% at 0436-8 U.T. These increases are incompatible with simple impact zone theory, and possible mechanisms are suggested to explain them. N.A.Porter

BREMSSTRAHLUNG AND PAIR PRODUCTION AT ENERGIES > 10^{11} eV. See Abstr. 9744

SODIUM 22 IN THE METEORITE BREITSCHEID. See Abstr. 9260

SCANDIUM 45 AS REACTION PRODUCT OF HIGH ENERGY PARTICLES IN IRON METEORITES. II. See Abstr. 9261

NUCLEUS

9795 THE EFFECT OF THE EXCLUSION PRINCIPLE ON THE REAL PART OF THE OPTICAL POTENTIAL.
J.Dabrowski and A.Sobiczewski.
Nuovo Cimento (Italy), Vol. 20, No. 2, 403-7 (April 16, 1961).

Corrections to the real part of the nucleon—nucleus optical potential are derived and expressed approximately in terms of nucleon—nucleon phase shifts. They increase the depth of the potential at energies up to 200 MeV and are small thereafter.
D.W.L.Sprung

9796 NUCLEAR INTERACTIONS IN THE SHELL MODEL.
S.P.Pandya and S.K.Shah.
Nuclear Phys. (Internat.), Vol. 24, No. 2, 326-33 (April, 1961).

A central two-body interaction that fits the energy levels of the

$(d_{3/2})(d_{3/2})$ and $(d_{3/2})(d_{3/2})^{-1}$ configurations observed in K^{38} and Cl^{36} is deduced. It is shown that this does not explain the very small splittings of the $s_{1/2}$-particle doublets in P^{30}, P^{32} etc.

9797 SHELL MODEL THEORY OF Pb^{205}.

W.W.True.

Nuclear Phys (Internat.), Vol. 25, No. 4, 155-68 (May, 1961).

The energy eigenvalues and eigenfunctions are calculated for the lower levels of Pb^{205} for a pure singlet-even two-body force between nucleons and for a singlet-even force plus weak coupling of the particle motion to the quadrupole collective motion of the core. Better agreement with experiment is found when weak coupling of the core is included. More experimental data are needed before a complete decay scheme for Pb^{205} can be determined.

9798 THE VIBRATIONAL QUADRUPOLE EXCITATION MODEL AND NON-AXIAL ROTATOR MODEL.

D.P.Grechukhin.

Nuclear Phys. (Internat.), Vol. 24, No. 4, 576-600 (May, 1961).

To elucidate the experimental possibilities of checking the non-axial rotator model and the vibrational model for nuclei with nearly equidistant spectra, a detailed comparison was performed of the predictions of these models for the following quantities: (1) the probabilities of E0, E2, E4, and M1 transitions of nuclei; (2) isotopic and isomeric shifts of the levels of atomic electrons; (3) quadrupole moments of nuclei in excited states. Experiments are proposed to test the non-axial rotator model for nuclei in the region of the transition from the equidistant spectrum to that of the axial symmetrical rotator.

9799 COLLECTIVE EXCITATIONS CORRESPONDING TO QUADRUPOLE NUCLEAR SURFACE VIBRATIONS.

A.S.Davydov.

Nuclear Phys (Internat.), Vol. 24, No. 4, 682-94 (May, 1961).

The solutions of the set of equations for the rotation—vibrational spectrum of non-spherical nuclei are investigated, γ-vibrations being taken into account in the equations. It is shown that zero-spin excited states can refer to β-vibrations as well as to γ-vibrations.

9800 FERMI—THOMAS TYPE APPROXIMATION FOR NUCLEI. K.Kumar and R.K.Bhaduri.

Phys. Rev. (USA), Vol. 122, No. 6, 1926-9 (June 15, 1961).

The Hartree—Fock to Fermi—Thomas reduction is carried through for finite nuclei, starting with the K-matrix formulation. The resulting expression represents the nuclear energy to good accuracy in terms of the density and its first derivatives only; it differs in detail from the semiempirical expressions previously proposed for this purpose. This improved expression shows the inadequacy of the "semi-infinite" approximation used often in earlier studies.

9801 ON THE COLLECTIVE MOTION IN EVEN—EVEN SPHERICAL NUCLEI. T.Marumori.

Progr. theor. Phys. (Japan), Vol. 24, No. 2, 331-56 (Aug., 1960).

A method formally analogous to that developed by Bogolyubov, Tolmachev and Smirkov (Abstr. 8158 of 1959) to investigate the collective excitations in superconductors is applied to even—even spherical nuclei in order to investigate the mechanism of the nuclear collective motion from the standpoint of particle excitations. The present theory leads, in principle, to the same results as those obtained by Belyaev (Abstr. 4961 of 1959). However, the method of description of the nuclear collective motion is quite different from that of Belyaev's paper, in which the "cranking model" of Inglis is employed, and the various physical parameters used by Belyaev can be derived uniquely from the "first" principle. Thus, in so far as the vibrational motion is concerned, the physical implication underlying the nuclear collective model proposed by Bohr and Pottelson is made clear.

9802 COLLECTIVE EXCITATION OF NUCLEAR MATTER.

S.Hatano.

Progr. theor. Phys. (Japan), Vol. 24, No. 2, 418-31 (Aug., 1960).

Collective excitations of nuclear matter which have their origin in the short-range interaction between nucleons in the nucleus are studied in order to correlate strongly excited level groups in nuclear reactions of relatively high energy with nuclear structure. Making use of an effective inter-nucleon potential which is determined from the analysis of pairing energies of various nuclei, the collective excitation energies are estimated in the one particle—hole pair approximation of the new Tamm—Dancoff method. Three stable modes of excitations are possible, that is, spin wave, isospin wave and coupled spin—isospin wave. Of these three modes the spin wave is the lowest exciting wave, the coupled spin—isospin wave is the second and the isospin wave is the highest. Each of them has its own critical momentum above which they become unstable. The strengths of coupling of these exciting waves with particle motion are also estimated. The higher exciting wave has the stronger coupling with particle motion and therefore the larger width of excitation energy. These exciting mechanisms would have some connection with the experimental results on inelastic scattering of nucleons and photonuclear reactions.

9803 EFFECT OF A REPULSIVE CORE IN A STATISTICAL MODEL OF HEAVY NUCLEI. V.Flores Maldonado.

Rev. Mexicana Fis., Vol. 9, No. 3, 163-79 (1960). In Spanish.

The binding energies of heavy nuclei are calculated on a statistical model, using a Yukawa plus repulsive core potential. The results are a considerable improvement on earlier calculations with a Yukawa potential only; it is suggested that further improvement might be obtained by taking a more realistic trial function, and a more repulsive core. I.J.R.Aitchison

9804 SEMIEMPIRICAL ATOMIC MASS LAW.

P.A.Seeger.

Nuclear Phys (Internat.), Vol. 25, No. 1, 1-135 (May, 1961).

New terms are proposed for the atomic mass law which incorporate effects of nuclear deformation and shell structure, including interference effects between unfilled neutron and proton shells. In addition, a surface-symmetry term is included. Coulomb terms are fixed by recent radii determinations in electron scattering. The standard deviation of calculated masses is reduced by the addition of the new terms as is the error in extrapolating from one side of the valley of beta stability to the other. The usefulness of the law for calculating the mass and binding energy of atoms with large neutron excess is discussed. A table giving mass excess, neutron, proton and alpha-particle binding energies, and beta decay transition energies is appended.

ATOMIC-BEAM INVESTIGATIONS OF NUCLEAR GROUND STATES IN THE RARE-EARTH REGION. See Abstr. 9900

NUCLEAR MAGNETIC MOMENTS OF Dy^{160} AND Er^{166}. See Abstr. 9834

9805 THE HARTREE PERTURBATION METHOD FOR HELIUM

A.Dalgarno and J.M.McNamee.

Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 673-6 (March, 1961).

The Hartree perturbation method is used to calculate the dipole polarizability, the electric field at the nucleus, the quadruple polarizability and the nuclear shielding factor of helium using a twelve-term representation of the unperturbed Hartree wave-functions. It is pointed out that the method yields lower bounds for the dipole and quadrupole polarizabilities. The absolute error in the predicted values of any of the quantities is less than 4.3%.

9806 THE NUCLEAR ZEEMAN EFFECT, AND QUADRUPOLE SPLITTING IN ^{119}Sn.

A.J.F.Boyle, D.St.P.Bunbury and C.Edwards.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 1062-8 (May, 1961).

The recoilless absorption of 24 keV γ-rays from Sn^{119m} was studied with the aid of a velocity spectrometer. Observations with the absorbing nuclei in different environments have enabled a value of 0.83 ± 0.03 n.m. to be given for the magnetic moment of the first excited state in Sn^{119}, and an upper limit of 3×10^{-8} eV to be put on the interaction energy between the quadrupole moment of this state and the gradient of the electric field in metallic tin.

9807 MÖSSBAUER EFFECT FOR Ni^{61} WITH APPLIED MAGNETIC FIELDS. H.H.F.Wegener and F.E.Obenshain.

Z. Phys. (Germany), Vol. 163, No. 1, 17-26 (1961).

The Mössbauer spectrum M(v) for the 71 keV γ-radiation of Ni^{61} is approximately five times as broad as the natural line width because of the magnetic hyperfine splitting. Using external fields, various polarizations of the internal magnetic fields in source and absorber are obtained, thus producing different forms for M(v). Theoretically deduced M(v) for E1, M1, E2 and M2 γ-radiations are given as functions of the nuclear spin, magnetic moments and magnetic fields of source and absorber. The measured form of M(v) gives information about the intrinsic magnetic field H in metallic nickel and about the nuclear moments μ_e (excited state) and μ_g (ground state). Hence the following are found: $\mu_e/\mu_g = -0.47 \pm 0.08$,

. . H) = [(26.0 ± 2.6) Mc/s](h . jg), and the direction of H is opposite the macroscopic magnetization. The value for (μ_g . H) is in isfactory agreement with magnetic nuclear resonance measure-nts.
E.A.Sanderson

POLARIZATION OF Co^{57} IN Fe METAL. See Abstr. 8877

9808
A MODEL OF HYPERFRAGMENTS.
G.Bhamathi and S.Indumathi.
ovo Cimento (Italy), Vol. 19, No. 4, 828-9 (Feb. 16, 1961).

Studies the possible hyperfragments of the Σ and Ξ hyperons th a view to determining the Σ—N and Ξ—N potentials, by consider-g the equivalence of the $\Sigma^-p\,(T = \frac{1}{2})$ and $\Lambda^0 n$ systems, and the $\Xi^- n$ d $\Lambda^0\Sigma^-$ systems.
E.A.Sanderson

9809
OBSERVATION OF A HYPERFRAGMENT DECAY BY π^0 EMISSION.
I.R.Kenyon.
ovo Cimento (Italy), Vol. 20, No. 1, 175-7 (April 1, 1961).

The partial analysis of a rare neutral hypernuclear decay is scribed where the π^0 is signalled by an electron pair from the ernal conversion of one of the decay γ-rays. The event is fortunately unsuited for analysis and only a tenuous interpretation its nature is given.
S.J.St-Lorant

nergy Levels

9810
ON VIBRATIONAL LEVELS IN EVEN—EVEN NUCLEI.
L.Simons.
mment. phys.-math. (Finland), Vol. 15, No. 7, 14 pp. (1961).

A complete knowledge has now been acquired about 2^+ levels heavy and medium weight even—even nuclei that can be two onon (K = 2) γ-vibrational levels. Except for in nuclei with arly closed shell structure, this level is found among the lowest cited levels. A very prominent rise in the energy of this level is ind when N and Z approach magic numbers and certain other mbers, too. This justifies the assumption that the energy can be pressed in the form

$$E = \frac{F(N,Z)}{(N - N_1)(N - N_2)\ldots(Z - Z_1)(Z - Z_2)\ldots}$$

ere N_i and Z_i are such "magic" or "half magic" numbers, N,Z) is a smooth function of the neutron number N and the proton mber Z. This actually turns out to be the case in every range nited by such N_i and Z_i values. Generally F(N,Z) is a linear ction of N and Z. In certain cases F is almost constant. Based known experimental values of confirmed vibrational levels in rtain nuclei such formulae can be used to deduce E values for clei with N and Z values close to the initial values. In this manner is concluded that the levels at 1182, 1400, 1740, 1500 and 1100 keV respectively Gd^{158}, Gd^{154}, Gd^{152}, Sm^{152} and Hg^{200} should be vibrational levels with 2^+ and K = 2.

9811
A NEW VARIATIONAL METHOD FOR CALCULATING EXCITED ENERGY LEVELS AND ITS APPLICATION) THE ANHARMONIC OSCILLATOR.
K.Yamazaki.
clear Phys. (Internat.), Vol. 24, No. 2, 313-17 (April, 1961).

The calculation agrees in the weak coupling limit with the rturbation calculation and for the strong coupling limit it also rees with the exact values within a 1% error.

9812
EVIDENCE FOR THE EXISTENCE OF ROTATIONAL LEVELS IN ALL EVEN NUCLEI.
C.A.Mallmann.
clear Phys. (Internat.), Vol. 24, No. 4, 535-75 (May, 1961).

A theory of rotations of even nuclei is developed which is more neral than the one based on the hydrodynamical model. It is sumed that the rotational motion can be treated adiabatically and it the three effective moments of inertia and the two effective adrupole moments are independent parameters. A small centri-gal distortion of the rotor is added as a correction term. The oretical predictions for energy levels and gamma-ray transition obabilities are compared with experimental results for nuclei th 40 ≤ A ≤ 250 and good agreement is obtained. The trends of the ective moments of inertia and effective quadrupole moments as a ction of A are given.

9813
THE MAGNETIC SPECTROGRAPH DATA ON LEVEL DENSITIES OF LIGHT NUCLEI.
Macdonald and A.C.Douglas.
clear Phys. (Internat.), Vol. 24, No. 4, 614-19 (May, 1961).

The magnetic spectrograph data on levels in nuclei of mass 18 to 34 are discussed, in relation to nuclear level densities and temperatures. It is pointed out that, contrary to the situation in nuclei with mass about 50, the level densities do not vary in a simple manner with the odd or even character of the nuclei. Some extensions of the magnetic spectrograph work are suggested.

9814
LOW-LYING ENERGY LEVELS IN Cl-35.
R.S.Storey and L.W.Oleksiuk.
Canad. J. Phys., Vol. 39, No. 6, 917-25 (June, 1961).

The reaction $Cl^{35}(p,p'\gamma)Cl^{35}$ was observed by the gamma radiation arising from the first two excited levels of Cl^{35}. Excitation functions for these radiations were measured for a range of proton energies from 2.3 to 3.25 MeV. Many sharp resonances are observed, of which a dozen are prominent. Angular distributions of the gamma-rays from the 1.22-MeV and the 1.76-MeV excited levels of Cl^{35} were measured over six resonances. The distribution functions, together with additional measurements by other investigators, yield spin assignments of 1/2 and 5/2 for the levels at 1.22 and 1.76 MeV respectively.

9815
HYPERFINE STRUCTURE SPLITTING OF RECOIL-LESS γ-LINES. I. THE 80.6 keV LEVEL IN Er^{166}.
R.L.Mössbauer, F.W.Stanek and W.H.Wiedemann.
Z. Phys. (Germany), Vol. 161, No. 4, 388-91 (1961). In German.

Using the method of recoil-less γ-emission and absorption the weakening of the 80.6 keV γ line in Er^{166}, embedded in Ho_2O_3 was measured in an Er_2O_3 absorber as a function of the velocity of the absorber. The temperature of both the source and the absorber was 20°K. A complex splitting scheme was obtained, containing components with line widths of the order of the lifetime of the excited state, corresponding to a mean line splitting for the source and absorber of approximately 1600 Mc/s.
S.J.St-Lorant

9816
STUDY OF THE FIRST LEVELS OF O^{18} BY THE REACTION $F^{19}(n,d)O^{18}$ BY MEANS OF A TELESCOPE SELECTING THE DEUTERONS.
C.Bonnel and P.Lévy.
C.R. Acad. Sci. (France), Vol. 250, No. 15, 2214-16 (April 10, 1961). In French.

14 MeV neutrons were used to bombard F^{19}. A coincidence arrangement permitted differentiation between protons and deuterons resulting from this bombardment in the energy range 2-12.8 MeV and considerable details are given of the experimental procedure adopted. Excited levels were found at 1.99, 2.45, 3.5, and 3.93 MeV respectively. The cross-section for the reaction is compared to that found by Ribes in earlier work.
B.Brown

9817
LOWER EXCITED STATES IN P^{29}.
T.Tabata, H.Fukuda and K.Okano.
J. Phys. Soc. (Japan), Vol. 15, No. 2, 364-5 (Feb., 1960).

The reaction $Si^{28}(p,\gamma)P^{29}$ was studied at the 367 keV resonance; γ-ray spectra were observed and some angular distribution measurements made. The latter are used to make some spin assignments.
L.L.Green

NUCLEAR DECAY
RADIOACTIVITY

9818
ON MEASUREMENTS OF DOSE BUILD-UP FACTORS FOR RADIATION PROTECTION PURPOSES.
H.G.Ebert.
Z. angew. Phys. (Germany), Vol. 13, No. 2, 95-9 (Feb., 1961). In German.

Describes a method for measuring B_∞, the dose build-up factor for a wall of infinite size, with an accuracy of ±5% and with relatively small absorbers (50 × 50 cm^2). This method is suitable for radiation shielding materials of high and medium atomic number Z. The results agree with existing values of B^+, the dose build-up factor for an infinitely extended medium containing both the source and the absorber, although disagreement appears for low Z materials. Values of B_∞ for Pb and barytes concrete (density 3.2 and 3.9 g cm^{-3}), obtained with 150 kV, 250 kV and 300 kV X-rays, Cs^{137} γ-rays (0.66 MeV), and Co^{60} γ-rays (1.17 and 1.33 MeV), are tabulated.
I.C.Demetsopoullos

9819 A DEVICE FOR THE MEASUREMENT OF RADIOACTIVITY IN THE HUMAN BODY.

A.Lansiart and L.Jeanmaire.

J. Phys. Radium (France), Vol. 20, Suppl. No. 12, 174A-176A (Dec., 1959). In French.

A sodium iodide crystal, 20 cm in diameter and 10 cm thick, is used with a lead shield 5 cm thick to measure the whole-body radioactivity content of supine persons enclosed in a lead-shielded tunnel. The apparatus is capable of detecting 10^{-8} curie of K^{40} and Cs^{137} in a normal individual with a background of 30 c/sec (100 kV-1.8 MeV), with a resolution of 16% obtained on a 25 channel pulse-analyser.

J.R.Mallard

9820 THE RADIOACTIVITY OF OPTICAL GLASS CONTAINING THORIUM.

W.Jahn.

Hausmitt. Jos. Schneider (Germany), Vol. 12, No. 3-4, 41-7 (1959-60). In German.

Measurements of the radioactivity of a number of glass blocks containing thorium are quoted. A short account of the value of thorium glasses in optics is given.

R.W.Fish

9821 THE CONCENTRATION IN AIR OF SMALL AND LARGE RADIOACTIVE IONS.

J.Brichard, J.Pradel and A.Renoux.

C.R. Acad. Sci. (France), Vol. 252, No. 14, 2119-21 (April 5, 1961). In French.

By applying the theory derived for small ions to RaA atoms, originating from the decay of atmospheric radon, the authors deduce the duration of the fixation of these atoms to the other particles in suspension in air. A relationship between free atoms and fixed atoms is also established and verified experimentally.

C.F.Barnaby

9822 GAMMA DOSE IN A HOLE IN A UNIFORMLY CONTAMINATED PLANE: CONTRIBUTION BY GROUND PENETRATION.

C.E.Clifford.

Canad. J. Phys., Vol. 39, No. 4, 604-7 (April, 1961).

Measurements were made of the dose distributions in a cylindrical hole (2 m diam. and 2 m deep; the wall, floor and lip of the hole being made of a sand and cement concrete) by ground penetration of γ-rays from uniform contamination of the surrounding plane by Cs^{137} (which γ-ray energy of 0.66 MeV is close to the average energy of γ-rays emitted by fission fall out, a few hours after detonation of a weapon). Comparison of the results with those calculated by Spencer (National Bureau of Standards) showed good agreement at lower depth, while at shallow depths the experimental values are lower. Measurements were made also on the dependence of the ground penetration dose on the area of contamination, and the individual dose measurements were integrated and analysed in view of studying the lip penetration, and lip geometry buildup factors were studied by means of laboratory experiments.

L.Mordecai

9823 CAESIUM-137 FALL-OUT OVER NORWAY SINCE SEPTEMBER 1956.

T.Hvinden, D.Hveding, A.Lillegraven and S.H.Small.

Nature (GB), Vol. 188, 1177-8 (Dec. 31, 1960).

In an earlier paper [Nature (GB), Vol. 185, 805 (March 19, 1960)] it was reported that current ratios of radioactivity in the lower stratosphere over south-east Norway had apparently increased for a month or two after high-yield test explosions and then decreased with an effective half-life of about one month, corresponding to a residual half-life of about three months. Concentrations in the lower troposphere appeared to have increased for about six months before decreasing at about the same rate as in the lower stratosphere. It was suggested that deposition of fall-out materials from many explosions may have been fairly continuous, lasting months instead of years and that during periods of frequent testing there may have been considerable mixing of fall out materials from different explosions. These conclusions were based on measurements of gross β-activities. The measurements of concentration of caesium-137 in the same precipitation samples are described, using a γ-spectrograph. The mean values (per metre^2 and per litre of precipitation) for each period of two months between September 1956 and June 1960 are given. Generally speaking the deposition of casium-137 followed the same sort of pattern as the overall deposition of β-emitting isotopes. It is concluded that fall-out materials from many high yield tests have reached the lower troposphere within a few months and been deposited rather rapidly.

C.F.Barnaby

9824 SOUTHERN HEMISPHERE FALL-OUT AND THE MERIDIONAL CIRCULATION.

A.J.Dyer.

Nature (GB), Vol. 189, 905-6 (March 18, 1961).

Monthly fall-out data at Melbourne for the period Jan. 1958 to Dec. 1960 are given and it is shown that the measurements give additional support to the idea that the meridional circulation plays a significant part in determining the global fall-out pattern. The observed seasonal variation is discussed. The total β-activity of fall-out during 1959 measured at Melbourne was 13 mc/km^2, which gives an estimated strontium-90 fall-out of 1 mc/km^2.

C.F.Barnaby

9825 HALF-LIFE OF B^{12}, NA^{24m}, AND AS^{75m}.

A.W.Schardt.

Phys. Rev. (USA), Vol. 122, No. 6, 1871-4 (June 15, 1961).

The following half-lives were measured: B^{12}, $(20.32 \pm 0.20) \times 10^{-3}$ sec; the 472 keV level of Na^{24}, $(19.9 \pm 0.3) \times 10^{-3}$ sec; and the 305 keV level of As^{75}, $(16.8 \pm 0.4) \times 10^{-3}$ sec. The activities were produced with a pulsed beam from a Van de Graaff generator. The data were taken with gated radiation-detection circuits in conjunction with a 9 channel time-delay analyser, and the half-lives were determined by least-squares analysis.

9826 DELAYED ALPHA PARTICLES FROM N^{16}.

R.E.Segel, J.W.Olness and E.L.Sprenkel.

Phil. Mag. (GB), Vo. 6, 163-5 (Jan., 1961).

Nitrogen gas enriched to 96% in N^{15} was bombarded by 2 MeV deuterons to produce N^{16} and the α-particle spectrum following the β-decay was observed using silicon counters. A single prominent α-particle group corresponding to the broad level at 9.58 MeV in O^{16} was observed. Although the β transition to this state is allowed, the log ft value is found to be 7.2 ∓ 0.2. This large inhibition of the β decay is attributed to the state being due to three nucleon excitation. The α-particle width of the parity forbidden transition from the 8.88 MeV level is estimated to be less than 3.9×10^{-7} eV, which predicts a value of $\mathfrak{F}^2 \leq 1.3 \times 10^{-10}$ for the parity nonconservation in this transition. An upper limit for the log ft value estimated for the β transition to the 9.84 MeV state is found to be consistent with the previous assignment of 2+ to this state.

J.B.Garg

9827 ANGULAR DISTRIBUTIONS IN β-DISINTEGRATION.

J.de Oyarzabal.

Rev. Mexicana Fis., Vol. 9, No. 1, 1-33 (1960). In Spanish.

The probability of allowed transitions in β-decay is obtained theoretically and the possible contribution of the terms of the probability function to violation of the conservation principles of parity, time reversal and charge conjugation is discussed. In addition to Coulomb corrections, the effect of a non-zero neutrino or antineutrino mass is also considered.

I.C.Demetsopoullos

9828 SYSTEMATIC TRENDS IN HALF-LIVES OF BETA-DECAYING NUCLEIDES.

G.Andersson.

Nuclear Phys (Internat.), Vol. 24, No. 4, 666-74 (May, 1961).

Linear relationships between log $T_{1/2}$ and A are shown to exist among neutron deficient Pb and Tl nuclides, if odd and even mass numbers are taken separately and $T_{1/2}$ is the pure beta half-life. The same simple systematics is found to apply to numerous other series of alternate isotopes, neutron rich as well as neutron deficient ones, indicating its usefulness in predicting half-lives. Attempts to establish the conditions for occurrence of these regularities meet with difficulties owing to the lack of experimental data. The probable spin and parity dependence of the systematics may enable it to suggest level assignments in certain cases of isomerism.

9829 STUDY OF MERCURY-192 DISINTEGRATION.

J.Jastrzębski and P.Kilcher.

C.R. Acad. Sci. (France), Vol. 252, No. 15, 2220-2 (April 10, 1961). In French.

Isotopically separated Hg^{192} (from Au irradiated by 150 or 75 MeV protons) was subjected to β-spectroscopy employing a Slätis—Siegbahn β-spectrometer of intermediate focusing, modified for β—γ coincidence measurement and an 180° spectrograph with photographic film. The transition energies of 15 transitions were identified, and the conversion rays observed for these transitions were stated. The disintegration period was measured to be 4.85 ± 0.20 hr. The relative intensities of several γ-rays were estimated and attempts were made to measure the periods of three of the more important transitions, succeeding only in determining their upper limits.

L.Mordecai

9830 BETA-DECAY OF ^{16}N: CONSERVATION OF SPIN AND PARITY IN ^{16}O.

E.Alburger, R.E.Pixley, D.H.Wilkinson and P.Donovan.
il. Mag. (GB), Vol. 6, 171-4 (Jan., 1961).

A thick target of TiN^{15} was bombarded by deuterons of 1.1 MeV produce N^{16}, and the α-particle spectrum following its β-decay s measured using solid state detectors. From a comparison of e experimental results with the calculated shape of the spectrum e to the allowed α-particle transition from the broad 9.58 MeV vel in O^{16}, a value of $\Gamma_\alpha/\Gamma_\gamma \leq 2.4 \times 10^{-5}$ for the parity forbidden -particle transition from the 8.88 MeV level was estimated. This perimental value of $\Gamma_\alpha/\Gamma_\gamma$, when combined with the I.P.M. lculations of the absolute width of the 8.88 MeV level and the -particle width for an allowed transition gives a value of $= 7 \times 10^{-12}$ for the parity non-conservation in this transition. ternatively an upper limit of 2×10^{-12} for the intensity of an mixture of J = 1 in this state is estimated. J.B.Garg

9831 BETA DECAY OF Tm^{171}.

B.L.Sharma.
uclear Phys (Internat.), Vol. 25, No. 1, 175-6 (May, 1961).

Er$_2$O$_3$ enriched in the isotope Er^{170} (87.3%) was exposed to a ermal neutron flux of 10^{12} cm^{-2} sec^{-1}. In order to study the beta ecay of Tm^{171} (1.9 yr), the Er fraction showing strong 7.5 hr tivity of Er^{171}, obtained by ion exchange column separation of r^{170} + n, was allowed to decay for a considerable time. The well rystal measurements were then made. Apart from Yb K X-rays d their escape peaks, the measurements showed the presence of highly internally converted photopeak at 67 keV. The proposed ecay scheme of Tm^{171} together with the spin assignments of rious states are discussed.

9832 MONOENERGETIC POSITRONS.

H.J.Leisi, J.H.Brunner, C.F.Perdrisat and P.Scherrer.
elv. phys. Acta (Switzerland), Vol. 34, No. 2, 161-88 (1961).
German.

Experimental proof of a nuclear de-excitation process which is aracterized by the emission of monoenergetic positrons is given. his process, predicted by Sliv (Abstr. 9898 of 1955) was observed llowing the electron-capture decay of Bi^{206} to the 3403 MeV level Pb^{206}. From the measured intensity of the "K-positron line" the tio of the nuclear lifetime to the lifetime of the vacancy in the ectronic K-shell has been computed. Using data of atomic level idths the authors find the total nuclear lifetime of the 3.403 MeV the $\tau = 1.8 \times 10^{-15}$ sec. The transition probabilities for gamma-ys emitted from this level are computed from the relative trans-ion intensities and compared with some general predictions of the ell model. 40 refs.

9833 GAMMA–GAMMA DIRECTIONAL CORRELATION IN Ba^{136} AND Mo^{94}.

H.Bernstein and H.H.Forster.
uclear Phys. (Internat.), Vol. 24, No. 4, 601-6 (May, 1961).

The γ–γ directional correlation was measured for the 065 MeV–0.830 MeV γ-cascade in Ba^{136} and for the 700 MeV–0.874 MeV cascade in Mo^{94}. The experimental rrelation is compatible with either a $4^+(Q)2^+(Q)0^+$ or a $^+(D + Q)2^+(Q)0^+$ level sequence for the lowest states in either cleus. A 2^+ assignment for the second excited state leads to predominantly M1 transition between the second and first excited ate, e.g., the quadrupole content in Ba^{136} is 2.7 ± 0.6%, that of o^{94} is 4.4 ± 0.4%.

9834 INFLUENCE OF PARAMAGNETISM ON ANGULAR CORRELATION (MEASUREMENT OF THE NUCLEAR AGNETIC MOMENT OF Dy^{160} AND Er^{166}).

W.Kündig.
elv. phys. Acta (Switzerland), Vol. 34, No. 2, 125-60 (1961).
German.

Angular correlation investigations were undertaken in order to ucidate the influence of extranuclear fields. It is shown that for e γ–γ cascades of Dy^{160} and Er^{166}, most of the observed tenuation effects can be explained by magnetic interaction of the ectron shell with the magnetic dipole moment of the nucleus. A ethod for determination of nuclear moments in paramagnetic aterials is described. Experimental results indicate that the agnetic field H_0 which influences the nuclear spin precession is e external field H_{ext}. modified by a paramagnetic correction ctor: $H_0 = H_{ext}\cdot\{1 + C'/(T - \epsilon)\}$. The g-factors of the first tational state of two even–even nuclei were measured; for Dy^{160}, $_N = 0.46 \pm 0.05$ and for Er^{166}, $g_N = 0.36 \pm 0.06$. The γ–γ angular rrelation behaviour on reversal of the magnetization of ferromagnetic Tb was investigated. Thence the mean life of the first vibrational state of its decay product, Dy^{160}, was determined as $\tau_N = (1.1 \pm 0.4) \times 10^{-12}$ sec. 37 refs.

9835 CIRCULARLY POLARIZED BETA–GAMMA CORRELATION MEASUREMENTS ON Re^{186}.

J.P.Deutsch and P.Lipnik.
Ann. Soc. Sci. Bruxelles I (Belgium), Vol. 74, No. 3, 195-9 (1960).
In French.

Preliminary results of beta–gamma directional correlation polarization measurements at $\theta = 180^\circ$ on the non-unique first-forbidden beta-transition of Re^{186} are given. Polarization found ($A' = 1.04 \pm 0.29$) furnishes an additional proof that this transition cannot be described in the framework of ξ-approximation. Measurements are extended to other values of θ.

9836 A GAMMA RAY IN Ti^{45} DECAY.

C.Ishii and K.Takahashi.
J. Phys. Soc. Japan, Vol. 15, No. 4, 736-7 (April, 1960).

Very pure metallic Ti was activated by 25 MeV bremsstrahlung from a betatron in the internal target, producing Ti^{45} activity ($T_{1/2}$ = 3.1 hr) by the reaction Ti^{46}(γ,n)Ti^{45}. The γ-rays in coincidence with one of the 0.51 γ-rays created by positron annihilations were looked for using a fast–slow coincidence circuit (2T = 80 mμsec) with two NaI:Ti crystals ($1\frac{1}{2} \times 1\frac{1}{2}$ in.) at right angles, the Ti sample being 4 cm from each. By suitable geometry and procedure a weak γ-ray (0.3% of the total decay) of 0.38 MeV with ~ 3 hr half-life was found, and was assigned to the transition from the first excited state of Sc^{45} at 0.377 MeV. A very weak γ-ray (less than 0.1% of the total decay) of 0.541 MeV may exist. The results are analysed and a decay scheme for Ti^{45} is predicted on the basis of this discussion. The results have enabled compilation of the systematics of log ft values for nuclei with $(f_{7/2})^n$ configurations. L.Mordecai

9837 PENETRATION MATRIX ELEMENTS AND NUCLEAR STRUCTURE EFFECTS IN Tl^{203}.

T.R.Gerholm, B.G.Pettersson, B.van Nooijen and Z.Grabowski.
Nuclear Phys. (Internat.), Vol. 24, No. 2, 177-95 (April, 1961).

Gamma–gamma, electron–gamma and gamma–electron angular correlation experiments on the $d_{\frac{5}{2}}$(400 keV) $d_{\frac{3}{2}}$(279 keV)$s_{\frac{1}{2}}$ cascade in Tl^{203} are reported. The following results were obtained: $A_2(\gamma\gamma) = -0.130 \pm 0.006$, $A_2(e\gamma) = -0.011 \pm 0.004$, $A_2(\gamma e) = -0.030 \pm 0.003$. In addition the K-conversion coefficient of the 400 keV transition was determined from the coincidence experiments. The value obtained is $\beta_1{}^K(400\text{ keV}) = 0.145 \pm 0.007$. The experiments were performed in order to search for nuclear structure effects in the M1 internal conversion process. These effects are expected to be negligible in the *l*-allowed (400 keV) transition. This is confirmed by the experiments which are in perfect agreement with the theory assuming no nuclear structure effects. Large nuclear structure effects are to be expected for the strongly retarded *l*-forbidden (279 keV) transition. This is also confirmed by the angular correlation experiments. It is shown that all experimental data are consistent with a λ-value of + 76 ± 1, where λ is defined as the ratio of the penetration matrix element and the normal gamma ray matrix element. The value for the weighting factor C(Z, k) was taken to be 0.0260. The errors for λ given here do not include the uncertainty in the weighting factor which is supposed to be known to within ± 10%. The agreement between the theory and the experimental results is further improved if the particle parameters are corrected~~fe~~ for the finite size of the nucleus in the E2 conversion process.

9838 PENETRATION MATRIX ELEMENTS AND NUCLEAR STRUCTURE EFFECTS IN Tl^{201}.

B.G.Pettersson, T.R.Gerholm, Z.Grabowski and B.van Nooijen.
Nuclear Phys. (Internat.), Vol. 24, No. 2, 196-222 (April, 1961).

The study of nuclear structure effects in internal conversion discussed in the preceding paper (see preceding abstract) was extended to the neighbouring nucleus Tl^{201}. Gamma–gamma. electron–gamma and gamma–electron correlations were measured. The following results were obtained:

$$\begin{aligned}
A_2(946 + 907\gamma - 330\gamma) &= +0.72 \pm 0.04,\\
A_2(946 + 907\gamma - 330e) &= +0.210 \pm 0.007,\\
A_2(361\gamma - 330\gamma) &= -0.20 \pm 0.08.\\
A_2(361\gamma - 330e) &= -0.09 \pm 0.01,\\
A_2(361e - 330\gamma) &= +0.001 \pm 0.004,\\
A_2(585\gamma - 330e) &= +0.022 \pm 0.015,\\
A\ (585\gamma - 361e) &= -0.013 \pm 0.008.
\end{aligned}$$

From coincidence and single counting rates the following conversion coefficients were determined:

$$\alpha_K^{(330)} = 0.113 \pm 0.008, \quad \alpha_K^{(361)} = 0.21 \pm 0.025, \quad \alpha_K^{(585)} = 0.06 \pm 0.01.$$

A decay scheme including 17 transitions and 9 excited states was established. The angular correlations and conversion coefficients were used to determine the spins and parities for the first, second and fifth excited states as well as the multipolarities, characters and mixing ratios of the most intense transitions. The results were analysed in terms of nuclear structure effects in the conversion process. The conclusions reached in Pt I were confirmed, i.e. for the $d_{\frac{5}{2}} \rightarrow d_{\frac{3}{2}}$ M1 transition there is no evidence for nuclear structure effects in agreement with what is to be expected from the theory. For the strongly retarded l-forbidden $d_{\frac{3}{2}} \rightarrow s_{\frac{1}{2}}$ M1 transition the experimental data are in complete agreement with the theory for $\lambda = +74 \pm 3$, where λ is defined as the ratio of the penetration matrix element and the corresponding gamma ray matrix element. The value for the weighting factor $C(Z, k)$ was taken to be 0.0274. The errors for λ given here do not include the uncertainty in the weighting factor which is supposed to be known to within ±10%. Thus the evidence for large nuclear structure effects in the internal conversion process found for the 279 keV transition in Tl^{203} was confirmed for the analogous 330 keV transition in Tl^{201}. The λ-values for these two transitions are in close agreement. Corrections for static finite size effects in the E2 conversion process were applied and as in the case of Tl^{203} these corrections were found to be small. It is concluded that the present formulation of the theory of internal conversion, including nuclear structure dependent factors, is fully consistent with the experimental data. Experimentally determined penetration matrix elements provide new pieces of information about the nuclear structure. It is shown that in order to get a unique determination of the λ-parameter it is necessary to determine both the internal conversion coefficient and the electron–gamma angular correlation.

9839 MAGNETIC AND QUADRUPOLE INTERACTIONS IN Hg^{197m}. ANGULAR CORRELATIONS.

B.G.Pettersson, J.E.Thun and T.R.Gerholm.

Nuclear Phys. (Internat.), Vol. 24, No. 2, 223-42 (April, 1961).

A series of electron–gamma angular correlation studies of the 165-134 keV cascade in Hg^{197m} and the 130-279 keV cascade in the decay-product Au^{197m} are reported. The experiments were undertaken primarily to settle the problem of the possible existence of a time dependent coupling between the nucleus and the electron core excited by virtue of a preceding conversion or electron-capture process. For the Au^{197m} cascade no observable attenuations of the angular correlation pattern were found due to the short lifetime (2.3×10^{-11} s) of the intermediate level. The Hg^{197m}, where the corresponding lifetime is 1×10^{-8} s, the correlation was found to be attenuated by a static quadrupole interaction for carrier-free sources deposited onto different metal and insulator backings. No measurable attenuation due to an interaction with the electron core was seen for metallic source backings. However, an additional attenuation attributed to the after-effects of the conversion-process was found for sources embedded in insulating environments. The interplay between the two different types of interaction gives a complicated attenuation mechanism, which, however, can be disentangled by means of time-differential angular correlations. A direct proof of the existence of an attenuation-effect due to the excitation of the electron core is furnished by a magnetic decoupling experiment, confirming the results obtained in the correlation experiments.

9840 EXPERIMENTAL DETERMINATION OF THE CONVERSION COEFFICIENT OF THE 412 keV E2 TRANSITION IN Hg^{198}.

B.G.Pettersson, J.E.Thun and T.R.Gerholm.

Nuclear Phys. (Internat.), Vol. 24, No. 2, 243-50 (April, 1961).

The K-conversion coefficient of the 412 keV transition in Hg^{198} was measured using a coincidence method. The result obtained $\alpha_K = 0.0305 \pm 0.0010$ is in agreement with the theoretical value for a pure E2 transition as calculated by Rose and by Sliv and Band.

9841 PENETRATION MATRIX ELEMENTS AND NUCLEAR STRUCTURE EFFECTS IN Ta^{181}.

Z.Grabowski, B.G.Pettersson, T.R.Gerholm and J.E.Thun.

Nuclear Phys. (Internat.), Vol. 24, No. 2, 251-68 (April, 1961).

Gamma–gamma and electron–gamma angular correlations in Ta^{181} were measured. The following results were obtained:

$$\begin{aligned}
G_2A_2(133\gamma + 137\gamma - 482\gamma) &= -0.065 \pm 0.003,\\
G_2A_2(137\gamma - 482\gamma) &= -0.04 \pm 0.015,\\
G_2A_2(133K - 482\gamma) &= -0.118 \pm 0.005,\\
G_2A_2(137K - 482\gamma) &= +0.030 \pm 0.013,\\
G_2A_2(133\gamma + 137\gamma - 482K) &= -0.005 \pm 0.003,\\
A_2(346\gamma - 136K) &= +0.02 \pm 0.01.
\end{aligned}$$

The quadrupole attenuation factor G_2 was determined by delayed angular correlations and found to be the same in the gamma–gamma and electron–gamma correlations. The value obtained is $G_2 = 0.22 \pm 0.015$. An independent determination of G_2 based on a comparison between $G_2A_2(133\gamma + 137\gamma - 482\gamma)$ and the value for $A_2(133\gamma + 137\gamma - 482\gamma)$ obtained by other groups using low viscosity liquid sources gave $G_2 = 0.23 \pm 0.015$. In addition the following two conversion coefficients were determined from electron–gamma coincidence data: $\alpha_K(133) = 0.54 \pm 0.08$, $\alpha_K(482) = 0.026 \pm 0.002$. The results were used to analyse the 482 keV conversion process in terms of nuclear structure dependent conversion matrix elements. The 482 keV transition is of mixed E2/M1 character. The mixing ratio becomes $\delta(482) = 6.4 \pm 0.8$. The M1 conversion process is strongly affected by the penetration terms. The M1 conversion coefficient is about 10 times larger than the normal finite size corrected value. From the conversion coefficient and the angular correlations the parameter λ, defined as the ratio of the penetration matrix element and the normal gamma-ray matrix element, becomes $-70 \geq \lambda \geq -125$. The large λ-value is a consequence of the large retardation of the 482 keV M1 transition. For the strongly retarded 133 keV E2 transition, however, the conversion process is found to be normal. It is concluded that the spin of the 619 keV level is $+\frac{5}{2}$ in disagreement with earlier tentative assignments.

9842 DECAY SCHEME OF Sn^{113}.

R.C.Greenwood and E.Brannen.

Phys. Rev. (USA), Vol. 122, No. 6, 1849-52 (June 15, 1961).

The electron capture decay of Sn^{113} was investigated using scintillation detectors and coincidence circuitry. Decay was found to occur to the 650 and 393 keV states of In^{113} with branching ratios of (1.8 ± 0.1)% and (98.2 ± 0.1)%, respectively. The 650 keV state decayed by the emission of a 255 keV gamma ray to the 393 keV state. No evidence was found for the existence of a 648 keV crossover transition. An upper limit for the intensity of this transition was placed as 0.1% of that of the 255 keV transition. The orbital electron capture ratio to the 648 keV state was determined to be $(P_{LMN\ldots}/P_K) < 0.19$. From this value, a minimum decay energy to the 648 keV state was assigned as 150 keV. It was determined that transitions to the 393 keV state of In^{113} were first-forbidden by considering log ft values; this is consistent with a spin and parity of $\frac{1}{2}+$ or $\frac{3}{2}+$ for the ground state of Sn^{113}. The 648 keV state was assigned a spin and parity of $\frac{1}{2}-$ or $\frac{3}{2}-$ on the basis of possible log ft values and the absence of the 648 keV crossover transition.

9843 K-CONVERSION COEFFICIENTS OF E2 TRANSITIONS.

M.K.Ramaswamy.

Nuovo Cimento (Italy), Vol. 18, No. 6, 1287-8 (Dec. 16, 1960).

Recently Subba Rao (Abstr. 15554 of 1960) plotted the ratio of the experimental to the theoretical values of α_K, the K-shell conversion coefficient for a number of $2^+ - 0^+$ first excited state to ground state γ-transitions in even–even nuclei and concluded that α_K might be dependent on nuclear deformation. A similar plot for $0^+ - 2^+$ transitions in Pd^{106}, Sm^{152}, Gd^{152}, and Er^{166} was made and provides some further, but not very conclusive, evidence for the same effect.

R.E.Meads

9844 STRUCTURE OF THE LINE AT 2892 GAUSS CM IN THE CONVERSION ELECTRON SPECTRUM OF THE ACTIVE DEPOSIT OF RdTh.

J.L.Wolfson.

Canad. J.Phys., Vol. 39, No. 3, 468-70 (March, 1961).

A complex line at 2892 gauss cm occurs in the internal conversion electron spectrum of the active deposit of RdTh. This was known to consist of the K conversion line of a 583 keV transition and the L conversion line of a 511 keV transition, both in Pb^{208}. The components were resolved using the 100 $\pi/\sqrt{2}$ air core spectrometer at Chalk River, and the following relative intensities of conversion electrons were obtained: 511 keV K line, 1.000; 583 keV K line, 0.687 ± 0.014; 511 keV L_I line, 0.173 ± 0.014; 511 keV L_{II} line, 0.021 ± 0.006. These results are discussed in relation to calculated internal conversion coefficients. The K/L_I ratio for the 511 keV transition, which could be an M1, E2 mixture has a value 8% lower than that calculated for pure M1 radiation. The ratio for the 583 keV transition, known to be pure E2 was in good agreement with the calculated value.

R.E.Meads

9845 FLUORESCENCE AND OTHER YIELDS OF THE L_{II} SHELL IN Pu.
algueiro, J.G.Ferreira, J.J.H.Park and M.A.S.Ross.
pc. Phys. Soc. (GB), Vol. 77, Pt 3, 657-64 (March, 1961).

A study was made of the L-radiation emitted after the disinte-
tion of Cm^{242} to determine, as accurately as possible, the
rescence and other yields of the L_{II} sub-shell in Pu. Obser-
ions were made (i) on the total intensity per disintegration of the
rays observing the L-ray photons in coincidence with α-particles
m Cm^{242}, (ii) on the relative intensity of the L-rays from the L_{II}
L_{III} sub-shells. The sensitivity of the curved crystal spectro-
ph used for the latter observations has been determined ~~previous~~
eviously. The experimental results are: fluorescence yield
= 0.413 ± 0.02, Coster—Krönig yield f_{23} = 0.22 ± 0.08, and Auger
ld a_2 = 0.37 ± 0.08. The total fluorescence yield of the L shells
= 0.486 ± 0.01. The values of ω_2 and ω are independent of
vious work on fluorescence yields, but for the distribution of
lds between f_{23} and a_2 it was necessary to use an extrapolated
ue of ω_3.

9846 GAMMA-RAY ANGULAR CORRELATIONS FROM ALIGNED NUCLEI PRODUCED BY NUCLEAR
ACTIONS. A.E.Litherland and A.J.Ferguson.
nad. J. Phys., Vol. 39, No. 6, 788-824 (June, 1961).

Two general procedures for measurement and analysis are
scribed which have wide applications in nuclear spectroscopy for
determination of spins and gamma-ray multipolarities. Cases
be studied by these methods when the reaction proceeds through
ompound state too complex to allow the usual analysis to be
de, for example where several levels overlap or where direct
eraction is dominant. The basis of these procedures is to
ploit the simplifications brought about by making the reacting
stem axially symmetric. A sharp gamma-ray-emitting state
med in such a system can be regarded as aligned and described
terms of a relatively small number of population parameters for
magnetic substates. In the first procedure, a state Y^* is
epared by a nuclear reaction $X(h_1h_2)\ Y^*$ in which h_2 is unobserved.
e state Y^* has axial symmetry about the beam axis. From
ncidence angular correlation measurements of two cascade
nma rays from Y^*, the unknown population parameters for Y^*
ether with the nuclear spins and gamma-ray multipolarities can
determined. In the second procedure, h_2 is measured in a small
unter at 0° or 180° relative to the incident beam. It is then shown
t the quantum numbers of the magnetic substates of Y^* which can
populated do not exceed the sum of the spins of X, h_1, and h_2. In
ses where the sum of the spins does not exceed $\frac{1}{2}$, the angular
rrelation of the gamma rays from the aligned state depends only
on the properties of the states in the residual nucleus. Theo-
ical expressions for angular correlations from aligned states
given, together with a method whereby existing extensive tables
coefficients can be used to calculate them. The results of two
cent experiments are discussed as examples.

9847 DECAY OF I^{132}.
R.L.Robinson, E.Eichler and N.R.Johnson.
ys. Rev. (USA), Vol. 122, No. 6, 1863-71 (June 15, 1961).

The decay was investigated by means of scintillation spectro-
eters. Energies (and relative intensities) of the gamma rays
ich were observed are 0.240 (1.3), 0.518 (15), 0.667 (100), 0.72 (5),
775 (63), 0.953 (15), 1.14 (1.2), 1.142 (2.7), 1.30 (2.4), 1.392 (6.4),
45 (1.1), 1.75 (0.3), 1.91 (0.7), 1.99 (0.8), 2.08 (0.18), 2.18 (0.13),
d 2.39 (0.11) MeV. The data indicate that the gamma-ray peak at
667 MeV actually consists of four gamma rays with energies
tween 0.62 and 0.68 MeV. An energy level diagram of Xe^{132} based
the present spectral studies and gamma—gamma angular cor-
lation measurements is proposed. Energies (and spins) of the
vels are 0.673 (2+), 1.32, 1.448 (4+), 1.81, 1.966 (3), 2.10 (3 or 4),
401 (4), 2.59 (3), and 2.84 (3, 4, or 5) MeV.

NUCLEAR REACTIONS

(Including scattering by nuclei)

SPALLATION OF INTERSTELLAR MATTER. See Abstr. 9251

Due to Photons

9848 HIGH ENERGY SCATTERING OF NUCLEON FROM NUCLEI. A PROPOSED MODEL AND ITS EXPERIMENTAL VERIFICATION. T.Sasakawa.
Progr. theor. Phys. (Japan), Vol. 24, No. 2, 241-58 (Aug., 1960).

Under the assumption that the short-range correlation between nucleons and the Pauli principle in the target nucleus in its ground state plays an essential role in high-energy elastic scattering, one can predict that the angular distribution of the high-energy elastic scattering from heavy nuclei is characterized by the following important results: (1) the positions of maxima and minima coincide respectively with those given by the impulse approximation; (2) the absolute value of the angular distribution is multiplied by a constant factor $|\lambda|^2$ to that given by the impulse approximation; (3) this factor is a constant independent of mass number and nearly independent of the incident energy in heavy nuclei; (4) the magnitude of $\sqrt{|\lambda|^2}$ is of order 0.4-0.5. This factor results from the Pauli principle in the target nucleus. In fact, analysis of the experimental data for the scattering of 95 MeV protons shows that the above expectation is valid. The factor $\sqrt{|\lambda|^2}$ is equal to 0.55 for Cu and heavier nuclei to Th, in the case of the meson theoretical phase shift. ($\sqrt{|\lambda|^2}$ = 1 for C, 0.75 for Al).

9849 MECHANISM OF INTERACTION OF FAST NUCLEONS WITH NUCLEI.
V.S.Barashenkov, V.M.Maltsev and E.K Mikhul.
Nuclear Phys (Internat.), Vol. 24, No. 4, 642-56 (May, 1961).

For previous work, see Abstr. 4088 of 1960. Results are given of calculations of intranuclear cascades generated by a 9 GeV proton in photoemulsion nuclei. From comparing these results with the available experimental data it follows that an intranuclear cascade mechanism is operating in nucleon—nucleus collisions at E = 9 GeV just as at lower energies. What the nucleon—nucleus interaction mechanism is like at very high energies ($E \gg 10$ GeV) -whether it is a nucleon-tube mechanism or an intranuclear cascade mechanism-is still an open question.

Due to Protons

9850 NOTE ON THE POLARIZATIONS OF NUCLEONS SCATTERED FROM LIGHT NUCLEI. Y.Sakamoto.
Nuovo Cimento (Italy), Vol. 19, No. 4, 835-6 (Feb. 16, 1961).

An optical model calculation of the magnitude of polarization of 150 MeV protons scattered from α-particle type nuclei is made taking into account the charge distribution as well as the effects of the pair correlations of nucleons in the target nucleus. The calculated values of the polarization taking into account the latter effects are in good agreement with the experimental data.

J.B.Garg

9851 POLARIZATION OF 9 MeV PROTONS ELASTICALLY SCATTERED FROM C AND Al.
D.Hoare, A.B.Robbins and G.W.Greenlees.
Proc. Phys. Soc. (GB), Vol. 77, Pt 4, 830-2 (April, 1961).

The polarization of 9 MeV protons, elastically scattered from C and Al, has been measured using a double scattering technique. The polarization was obtained from the left—right scattering asymmetry from helium as recorded in photographic emulsions. Angular distributions from the polarization and elastic scattering cross-section are compared with predictions of optical model calculations. The general features of the scattering from aluminium are described by the optical model calculation, while the scattering from carbon appears to have strong contributions from sources other than the shape—elastic scattering.

9852 ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM NICKEL ISOTOPES; Ni^{58} AND Ni^{60}, IN THE ENERGY RANGE FROM 7.0 MeV TO 15.3 MeV.
S.Kobayashi, K.Matsuda, Y.Nagahara, Y.Oda and N.Yamamuro.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1151-7 (July, 1960).

Angular and energy dependence of the scattering were investigated. Angular distributions in the high energy region ($E_p \geq 10$ MeV) showed small difference between both isotopes. Energy dependence of the differential cross-sections in the low energy region (7 MeV $< E_p <$ 9 MeV) showed some fluctuations both for the elastic and the inelastic scattering. The inelastic yield for Ni^{58} was larger than that for Ni^{60} in the low energy region ($E_p \leq 9$ MeV). These yields decreased gradually as the incident energy increased. The results are compared with the authors' previous work and with the investigations of Thirion et al., Greenlees et al., and Seward.

9853 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY OXYGEN IN THE ENERGY REGION OF 6.9 MeV TO 15.6 MeV.

S.Kobayashi.

J. Phys. Soc. Japan, Vol. 15, No. 7, 1164-74 (July, 1960).

Results are presented, showing the variation with energy of the absolute angular distributions for the elastic and inelastic scattering. For the elastic scattering, angular distributions between 20° and 160° were obtained for 20 incident proton energies spaced between 6.87 MeV and 15.6 MeV. The absolute angular distributions for the inelastic proton groups, leading to the excitation of about 6 MeV (6.06 and 6.14 MeV) and 7 MeV (6.92 and 7.12 MeV) states of O^{16}, were measured at five energies from 11.9 MeV to 15.6 MeV. Although angular distributions vary remarkably with the incident energy, the integrated cross-section decreases monotonically as incident energy increases. In particular, at $E_p = 15.6$ MeV, the total inelastic scattering cross-section was roughly measured to be 240 ± 40 mb. From this result and the reported results for other reaction cross-sections, it can be deduced that the O^{16} nucleus is considerably transparent even for this rather high incident energy, where the mean free path of nucleon in nuclear matter has nearly the minimum value in usual nuclei. The excitation function for the elastic scattering shows appreciably sharp resonance at energies, 7.2, 10.6 and 14.7 MeV, and its gross structure has a large scale resonance of a width about 4 MeV, at incident energy of about 13 MeV. It appears that this resonance is the f-wave giant resonance expected from the shell model.

9854 SCATTERING BY Si^{28} OF PROTONS OF ENERGY 10.0—12.3 MeV.

A.V.Cohen and J.A.Cookson.

Nuclear Phys. (Internat.), Vol. 24, No. 4, 529-34 (May, 1961).

The excitation curve for inelastic scattering of protons in the energy range 10.0—12.3 MeV shows considerable structure. Angular distributions, both of this reaction and the elastic process, were determinded at two energies, and the elastic results are discussed in terms of the optical model.

9855 THE DETERMINATION OF THE IMAGINARY POTENTIAL IN THE OPTICAL MODEL.

J.Olkowsky and J.Raynal.

Nuclear Phys. (Internat.), Vol. 24, No. 2, 269-73 (April, 1961).

In French.

The Bjorklund—Fernbach optical model is applied to the determination of the imaginary potential W fitting the $(Pr^{141} + p)$ reaction cross-section at proton energies < 11.1 MeV. It is found that σ(reaction) is more sensitive to the shape of the imaginary potential than to its depth.

9856 γ-RAYS FROM THE 1.14 MeV RESONANCE IN $B^{10}(p,\gamma)C^{11}$.

A.N.James.

Nuclear Phys (Internat.), Vol. 24, No. 4, 675-81 (May, 1961).

The γ-rays were observed using a 15.2 cm long by 10.2 cm diameter NaI(Tl) scintillation spectrometer. As well as the ground-state γ-rays, cascades through the 4.32 and 6.48 MeV states were observed, the 6.48 MeV state decaying partly by a cascade through the 4.32 MeV level. A spin of $\frac{5}{2}$ – is proposed for the 9.74 MeV level in C^{11}.

9857 INTERFERENCE BETWEEN THE 930 keV AND 980 keV LEVELS IN THE 6.8 MeV GAMMA RAY YIELD FROM THE REACTION $Be^9(p,\gamma)B^{10}$.

L.Simons.

Comment. phys.-math. (Finland), Vol. 24, No. 8, 9 pp. (1960).

A unique case of overlapping of two levels in a (p,γ) reaction is investigated, the interference term being fully determined. The occurrence of this phenomena is concluded from the behaviour of the gamma yield of the reaction $Be^9(p,\gamma)B^{10}$ for 850 keV $\leq E_p \leq$ 1050 keV, the gamma radiation going to the 0.72 MeV level in B^{10}. The proposed spin and parity values 1^+ for the 930 keV level and 2^+ for the 980 keV level have as the only possibility p-wave protons and M1 radiation. The yield can be expressed in the form $W = C(1 + k\cos^2 \Theta)$, where C and k depend on the proton energy. C is fairly independent of couplings while k depends strongly on the coupling.

9858 GAMMA RAYS FROM SEVERAL ELEMENTS BOMBARDED BY 10 AND 14 MeV PROTONS.

T.Wakatsuki, Y.Hirao, E.Okada, I.Miura, K.Sugimoto and A.Mizobuchi.

J. Phys. Soc. Japan, Vol. 15, No. 7, 1141-50 (July, 1960).

Gamma-ray spectra and intensities from C, O, Mg, Al, Si, Ca, Ti, Cr, Fe, Ni, Cu, Ag, Cd, Sn, Pt, Au and Pb bombarded by 10 and 14 MeV protons were studied. For C, O, Mg, Si and Ca, most of the gamma-rays could be attributed to the inelastic scattering. New levels at 7.08 and 8.13 MeV are suggested in Ca^{40}.

9859 RESONANCES IN THE $K^{39}(p,\gamma)Ca^{40}$ REACTION FROM 1.0 TO 2.1 MeV.

R.A.Pope, D.V.Freck and W.W.Evans.

Nuclear Phys (Internat.), Vol. 24, No. 4, 657-65 (May, 1961).

Resonances were found at $E_p = 1133.0 \pm 1.4$, 1311.7 ± 1.6, 1349.3 ± 1.6, 1579.9 ± 1.9, 1769.7 ± 2.1 and 2046.7 ± 2.5 keV, half-widths all being less than 0.5 keV. A number of closely-spaced resonances in the region of $E_p = 1880$ keV were also observed. The main features of decay at each resonance were investigated.

9860 ON THE PARITY OF THE 441 keV $Li^7(p,\gamma)Be^8$ RESONANCE.

L.Simons.

Comment. phys.-math. (Finland), Vol. 24, No. 13, 15 pp. (1960).

The 441 keV resonance level in the reaction $Li^7(p,\gamma)Be^8$ has previously been assigned J = 1 and odd parity, but the results of certain scattering experiments are in favour of J = 1 and even parity. It is shown that the assignment 1^+ is inadequate to explain the experimental value for $W(E_p, 15^\circ)/W(E_p, 145^\circ)$. Calculations based on the assumption that one or several levels of opposite parity interfere yield an interference term that is too small. The experimental value for $W(E_p, 15^\circ)/W(E_p, 145^\circ)$ can very well be explained if the 441 keV level is assigned J = 1 and odd parity while one or several levels of opposite parity and the spin values 1 or 2 interfere. The spin value 1 will then yield a better fit to the angular distribution of the yield function $W(E_p,\Theta)$.

9861 RESONANCES IN AND GAMMA RAYS FROM $Mg^{25}(p,\gamma)Al^{26}$.

K.E.Nystén.

Comment. phys.-math. (Finland), Vol. 24, No. 9, 33 pp. (1960).

The reaction $Mg^{25}(p,\gamma)Al^{26}$ was investigated in the range E_p = 850-1400 keV, using a Van de Graaff accelerator and a scintillation detector. A new resonance at E_p = 970 keV was found, its intensity being 10% of that of the 956 keV resonance. Evidence was found for another resonance at E_p = 928 keV, although it could not be separated completely from the nearby 932 keV resonance. Gamma spectra was measured at the 956 and 990 keV resonances. The following gamma rays, not reported previously, were found: 7.23 and 6.81 MeV at E_p = 956 keV, and 7.25 and 6.87 MeV at E_p = 990 keV. They represent transitions from the resonance levels to the ground state and to the second excited level. The relative intensities were estimated. Different spin and parity assignments are discussed in terms of level schemes. It seems very likely that both resonance levels have j = 3, T = 1 and odd parity.

9862 (p,n) REACTIONS IN SOME MEDIUM-WEIGHT NUCLEI.

B.Lobkowicz and P.Marmier.

Helv. phys. Acta (Switzerland), Vol. 34, No. 2, 85-124 (1961).

In German.

The (p,n) reactions for V^{51}, Co^{59}, Cu^{65}, As^{75}, and Zr^{91} were studied by investigation of the characteristics of γ-rays emitted by the product nucleus. Measurements of coincidences and angular correlations were undertaken, from which it has been possible to suggest level schemes for the nuclei Cr^{51}, Ni^{59}, Zn^{65}, Se^{75} and Nb^{91}. Comparison of the respective partial cross-sections with the statistical theory of nuclear reactions was used to derive information regarding the spins of the excited levels. 51 references.

9863 EXCITATION FUNCTIONS OF THE (p,pn) AND (p,2p) REACTIONS ON Ce^{142} AT 60-233 MeV.

W.R.Ware and E.O.Wiig.

Phys. Rev. (USA), Vol. 122, No. 6, 1837-41 (June 15, 1961).

The cross-sections of the reactions $Ce^{142}(p,pn)Ce^{141}$ and $Ce^{142}(p,2p)La^{141}$ were determined for protons of 60, 120, 180, 200, and 233 MeV energy. A comparison is made of the observed yields with those predicted on the basis of Monte Carlo cascade-evaporation calculations at 83, 238, and 368 MeV. For protons of energy between 60 and 240 MeV the agreement is good for the (p,pn) reaction and fair for the (p,2p).

9864 EXCITATION FUNCTIONS OF THE (p, 2p6n) AND (p, 3p5n) REACTIONS FOR 60, 100, 150 AND 240 MeV PROTONS ON ENRICHED ZIRCONIUM-90.

E.Ünseren and E.O.Wiig.

Phys. Rev. (USA), Vol. 122, No. 6, 1875-6 (June 15, 1961).

The cross-sections of the $Zr^{90}(p, 3p6n)Sr^{83}$ and $Zr(p, 2p6n)Y^{83}$ reactions were determined for proton energies of 60-240 MeV.

cross-section for even—odd Sr^{83} production in the energy range
-240 MeV is 1330-2140 times as large as that of odd—even Y^{83}, as
rasted with much smaller values for the production of odd—odd
even—even isobars in similar reactions.

ıe to Neutrons

9865 EXCITATION OF Fe, Mn AND Mg LEVELS BY INELASTIC NEUTRON SCATTERING.
ehar, J.Skřivánek and M.Veselá.
ch. J. Phys., Vol. 10, No. 4, 335-6 (1960).
The energy spectra of the γ-rays produced during the inelastic
ttering of neutrons with a mean energy of 3.1 or 4.3 MeV was
ısured with a NaI scintillation spectrometer using toroidal
tterers. Values of the line energies are given with comments.
A.Ashmore

9866 CALCULATION OF THE ANGULAR DISTRIBUTION OF THE $Li^6(n,n\ \gamma)Li^6$ REACTION BY MEANS OF THE
ERMEDIATE COUPLING SHELL MODEL. C.M.Kotin.
. Mexicana Fis., Vol. 9, No. 2, 73-84 (1960). In Spanish.
The angular distribution function of the inelastic scattering
n,n)Li^{6*} and the angular correlation function of the reaction
n,n γ)Li^6 are derived theoretically using the value 1.08 for the
rmediate coupling parameter. I.C.Demetsopoullos

9867 AN EXPERIMENTAL TEST OF THE STATISTICAL THEORY OF NUCLEAR REACTIONS. D.L.Allan.
lear Phys. (Internat.), Vol. 24, No. 2, 274-99 (April, 1961).
The 14 MeV differential (n, p) cross-sections of about 40 nuclei
e measured at 120° to the incident neutrons using a photographic
e method. The results are compared with the cross-sections cal
ulated according to the statistical theory of nuclear reactions
it is shown that good agreement exists between theory and
eriment provided a level density function of the form $\exp 2(aU)^{\frac{1}{2}}$
a ≅ 0.1 A is used and the pairing energy δ is taken into account.
erimental values of δ and the nuclear temperatures are given.
(n, np) cross-sections of 13 of the nuclei were measured and the
ılts are discussed in terms of a reaction mechanism based on
statistical model.

9868 PROTONS AND DEUTERONS FROM Al^{27} BOMBARDED BY 14.8 MeV NEUTRONS. R.N.Glover and E.Weigold.
lear Phys (Internat.), Vol. 24, No. 4, 630-41 (May, 1961).
Angular distributions for direct interaction proton groups
responding to individual Mg^{27} levels were measured and shown
gree with theoretical predictions. Nuclear temperatures of
$\pm$0.15 and 0.49$\pm$0.02 MeV are found for the reactions (n,pγ) +
n) and (n,np), respectively. Cross-sections for proton emission
: total 273 ± 20 mb; (n,pγ) + (n,pn) 89 mb compound nucleus,
nb direct interaction; (n,np) 157 mb. Spins are assigned to
eral Mg^{27} levels from analysis of the present experiment and
revious Mg^{26} (d,p) Mg^{27} experiments. Angular distributions
euteron groups corresponding to Mg^{26} levels at 0,1.83 and
MeV are measured. Reduced widths are extracted and shown
gree with the predictions of the rotational model.

STUDY OF THE FIRST LEVELS OF O^{18} BY THE REACTION
n, d)O^{18} BY MEANS OF A TELESCOPE SELECTING THE
JTERONS. See Abstr. 9816

INTERACTION OF NEUTRONS WITH HE^3. See Abstr. 9779

9869 ABSOLUTE CROSS-SECTIONS OF THE REACTIONS $Na^{23}(n, p)Ne^{23}$ AND $Na^{23}(n, \alpha)F^{20}$. C.F.Williamson.
s. Rev. (USA), Vol. 122, No. 6, 1877-82 (June 15, 1961).
The absolute cross-sections for the competing reactions
$^3(n, p)Ne^{23}$ and $Na^{23}(n,\alpha)F^{20}$ were measured over the energy
ge 4 to 19 MeV by the activation method, using neutrons from
$H^2(d, n)He^3$, $N^{14}(d, n)O^{15}$, $C^{14}(d, n)N^{15}$, and $H^3(d, n)He^4$ reactions.
excitation curves thus obtained are compared with theoretical
ults based upon the statistical theory. A fair fit is obtained for
(n, p) reaction, but serious discrepancies exist between the
ısured and calculated (n,α) cross-sections.

9870 ORIGIN OF INTENSE GAMMA RADIATION FROM THE ABSORPTION OF SLOW NEUTRONS BY U^{235}.
Ietter, C.Corge, J.Julien, Vinh-Dinh Huynh and J.Morgenstern.
t. Acad. Sci. (France), Vol. 252, No. 12, 1759-61 (March 20,
1). In French.
An increase in the intensity of γ-radiation with an energy of
5 MeV relative to that of ~5 MeV is observed for a number of discrete energies of the incident slow neutrons from 4.8 to 19.3 eV. This increase is enhanced for those energies where the γ-radiation arises predominantly from radiative capture. V.M.Rout

Due to Mesons and Hyperons

9871 MEASUREMENT OF THE RATE $\mu^- + C^{12} \rightarrow B^{12} + \nu$.
E.J.Maier, B.L.Bloch, R.M.Edelstein and R.I.Siegel.
Phys. Rev. Letters (USA), Vol. 6, No. 8, 417-19 (April 15, 1961).

The muons were stopped in a 4 × 4 × 2 in. plastic scintillator. Electrons from muon decay and from B^{12} decay ($T_{1\ 2}$ = 20.3 msec) were observed in this counter, the latter in coincidence with a cosmic-ray shield. Allowing 10% for capture to excited states of B^{12} and neglecting production of bound B^{12} from C^{12} the partial capture rate to the B^{12} ground state was found to be $(6.31 \pm 0.24) \times \times 10^3\ sec^{-1}$. This result does not confirm the presence of the conserved vector current contribution indicated by some of the previous measurements. A.Ashmore

Due to Deuterons

9872 AN INVESTIGATION OF SELF-TARGETS FOR THE $D(d,n)He^3$ REACTION. R.Weisbeck.
Z. angew. Phys. (Germany), Vol. 12, No. 12, 529-38 (Dec., 1960). In German.

Describes experiments made to investigate the neutron yields from targets made by the occlusion of deuterium onto the surface of various materials. After a sufficiently long irradiation neutrons are produced by the $D(d,n)He^3$ reaction. Measurements of the neutron yields from 31 elements, 8 alloys and 1 compound were determined as a function of time using an 80 μ beam of 128 keV deuterons. R.H.Thomas

9873 ON THE POLARIZATION OF PROTONS IN (d, p) STRIPPING REACTIONS. E.Coffou.
Nuovo Cimento (Italy), Vol. 19, No. 5, 1055-7 (March 1, 1961).

An arbitrarily polarized deuteron beam incident on an unpolarized target is considered. A general formula is given subject to the assumption of zero-range n—p force and distorted wave Born approximation. The detection of initial state tensor polarization is discussed. D.W.L.Sprung

9874 A STUDY OF THE REACTION $^{40}Ca(d, n)^{41}Sc$.
B.E.F.Macefield, J.H.Towle and W.B.Gilboy.
Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 1050-61 (May, 1961).

The neutron time-of-flight technique was used. A ground state Q value of −1.145 ± 0.015 MeV was obtained which disagrees with previous measurements. Excited states of Sc^{41} were located at 1.709 ± 0.030 MeV and 2.476 ± 0.030 MeV. Angular distributions of the corresponding neutron groups were measured. The application of Butler stripping theory (1957) enables an assignment of $l = 3$ for the captured proton for the ground state and $l = 1$ for the 1.71 MeV state. An unambiguous assignment is not possible for the 2.48 MeV state.

9875 NUCLEAR SPECTRA OF F^{20}, O^{17}, AND O^{16} FROM (d, p), (d, α) AND (p, α) REACTIONS IN F^{19}, USING INCIDENT ENERGIES OF 1.8 MeV. J.Rickards C.
Rev. Mexicana Fis., Vol. 9, No. 1, 35-55 (1960). In Spanish.

The energies and angular distributions of the product particles were measured by a wide range magnetic spectrograph of high resolution. Two new levels were found in the F^{20} spectrum with excitation energies 1.851 ± 0.004 and 3.184 ± 0.004 MeV. The Q-values of the reactions were 4.382 ± 0.009, 10.059 ± 0.010 and 8.120 ± 0.006 MeV respectively. The calculated values of the nuclear masses of O^{17}, F^{19} and F^{20} were 17.000139, 18.999521 and 20.001409 a.m.u. respectively, taking the nuclear mass of O^{16} equal to 15.995611 a.m.u. I.C.Demetsopoullos

9876 AN INVESTIGATION OF NEUTRONS FROM THE REACTION $Mg^{25}(d,n)Al^{26}$ AT 2.00 AND 6.54 MeV DEUTERON ENERGY. A.Erdal and A.Graue.
Arbok Univ. Bergen mat.-nat. Ser. (Norway), 1960, Paper 15, 7 pp.

The neutrons emitted from thin Mg^{25} targets bombarded by 2.00 and 6.54 MeV deuterons were investigated using the photographic plate technique. The Q-values corresponding to the ground state in Al^{26} were found to be 4.10 ± 0.05 and 4.07 ± 0.09 MeV respectively. The measured levels in Al^{26} are in agreement with previous results. A probable level at 0.61 MeV was observed.

9877 ON THE ALPHA-PARTICLES FROM THE $N^{14}(d, \alpha)C^{12}$ GROUND STATE REACTION. N.Kawai.
J. Phys. Soc. Japan, Vol. 15, No. 5, 930 (May, 1960).

The differential cross-section was measured at eight energies between 1.43 and 2.90 MeV from 15°-105°. E.J.Burge

9878 THE $^{58}Ni(d, p)^{59}Ni$ AND $^{60}Ni(d, p)^{61}Ni$ REACTIONS. A.W.Dalton, G.Parry, H.D.Scott and S.Swierszczewski.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 682-90 (March, 1961).

Targets of natural nickel and isotopically pure Ni^{60} were bombarded by deuterons with energies of 8.9 MeV and 8.6 MeV respectively. From the resulting proton energy spectra a number of angular distribution measurements were made for the $Ni^{58}(d, p)Ni^{59}$ and $Ni^{60}(d, p)Ni^{61}$ reactions and spin and parity assignments made to states of Ni^{59} and Ni^{61}. The results were compared with the gross structure peaks in the proton spectra recently reported by Schiffer, Lee and Zeidman (Abstr. 13617 of 1959).

9879 (N – Z) DEPENDENCE OF RADIATIVE DEUTERON CAPTURE CROSS-SECTIONS.
J.H.Carver and G.A.Jones.
Nuclear Phys. (Internat.), Vol. 24, No. 4, 607-13 (May, 1961).

Induced radioactivity methods were used to determine the radiative deuteron capture cross-sections for Ni^{58} and Cr^{54} in the range of deuteron energies 3.5-4.5 MeV. When combined with previous measurements of the $Zn^{64}(d,\gamma)$ cross-section (Abstr. 8604 of 1959) these results give the (d,γ) cross-sections for nuclei with $N - Z = 2$, 4 and 6. If there is a strong contribution to the cross-sections from direct electric dipole capture they should be proportional to the deuteron penetration factor and to $(N - Z)^2/A^2$. No evidence is found for such a direct contribution. For $Ni^{58}(N - Z = 2)$ at a deuteron energy of 4.5 MeV, $\sigma(d,\gamma) = 61 \pm 9$ μb and $\sigma(d,n) = 85 \pm 12$ mb. For Cr^{54} $(N - Z = 6)$ at a deuteron energy of 4.5 MeV $\sigma(d,\gamma) = 295 \pm 45$ μb and $\sigma(d,p) = 75 \pm 12$ mb. These cross-sections are consistent with an interpretation in terms of the statistical decay of a compound nucleus, the radiative probability being determined from photodisintegration data.

Due to Alpha-particles

9880 OPTICAL MODEL ANALYSIS OF THE ELASTIC SCATTERING OF 5.5 MeV ^3He BY CARBON, MAGNESIUM, ALUMINIUM AND COPPER. P.E.Hodgson.
Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 997-1000 (May, 1961).

Recent measurements are analysed, and the values of the parameters of the potentials giving the best fit to the data are obtained.

9881 NOTE ON THE TWO-NUCLEON STRIPPING PROCESS. M.L.Rustgi.
Nuclear Phys (Internat.), Vol. 25, No. 1, 169-74 (May, 1961).

An expression is derived for the angular distribution of a process in which a neutron and a proton are captured from an incident He^3 nucleus and the stripped proton imparts an extra unit of angular momentum to the system (target nucleus + captured neutron and proton) by flipping its spin. No comparison with experiment is made because of the present lack of experimental data for such a process. An expression for the differential cross-section of a process in which two nucleons are captured from an incident He^3 or similar nucleus is derived in the zero-range approximation and compared with published theoretical results.

9882 ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES BY CARBON.
T.Mikumo, H.Yamaguchi, I.Nonaka, M.Odera, Y.Hashimoto, M.Kondo and T.Maki.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1158-63 (July, 1960).

Angular distributions of alpha-particles scattered elastically and inelastically $(Q = -4.43$ MeV) by a carbon nucleus were measured with incident alpha energies of 28.4, 31.0 and 33.6 MeV. Angular distributions of inelastic alpha groups corresponding to $Q = -7.66$ and -9.63 MeV and a broad alpha group with $Q \cong 12.7$ MeV were also obtained at $E_\alpha = 28.4$ MeV. The data were compared with Blair's diffraction scattering model and fairly good agreements were obtained for both elastic and inelastic $(Q = -4.43$ MeV) angular distributions for forward angles for three energies. The rises of cross-sections at back angles, however, seem to occur from other mechanisms. Spin and parity assignments were tried for 7.66 and 9.63 MeV levels of carbon.

9883 ANOMALIES IN THE ANGULAR DISTRIBUTIONS OF α-PARTICLES INELASTICALLY SCATTERED BY Fe^{56} AND Ni^{58}. R.Beurtey, P.Catillon, R.Chaminade, M.Crut, H.Faraggi, A.Papineau, J.Saudinos and J.Thirion.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1756-8 (March 20, 1961).
In French.

A study of the angular distributions showed that while Blair's theory is applicable to strongly excited levels, it cannot account for the parity of the slightly excited levels. This suggests that the two excitation mechanisms are different. B.Brown

9884 EVIDENCE FOR LOW-MOMENTUM-TRANSFER PROCESS IN $K^{41}(\alpha,n)Sc^{44m,g}$ REACTIONS FROM RANGE MEASUREMENTS OF PRODUCTS.
T.Matsuo and T.T.Sugihara.
Canad. J. Chem., Vol. 39, No. 3, 697-705 (March, 1961).

Average forward ranges were measured for the product nuclides Sc^{43}, Sc^{44m}, and Sc^{44g} as produced in the reactions $K^{41}(\alpha,xn)$ with alpha particles in the energy region 23 to 39 MeV. These ranges, which are determined by a thick target—thick catcher technique, indicate that the (α,n)-produced isomers are formed in part by a low-momentum-transfer process above 30 MeV, its contribution being larger for the ground-state nuclide Sc^{44g}. From a thick target—thin catcher experiment at 40 MeV, it is found that the range distribution for Sc^{43} is that expected for a compound-nucleus reaction. Normalizing the Sc^{44m} and Sc^{44g} activity distributions to that of Sc^{43} for the catchers farthest from the target, the lower limit for the contribution of a direct-reaction low-momentum-transfer process to the formation of Sc^{44m} and Sc^{44g} at 40 MeV are estimated to be about 30% and 46% respectively.

9885 THE ANGULAR DISTRIBUTIONS OF ALPHA PARTICLE GROUPS FROM THE REACTION $^{24}Mg(^3He, \alpha)^{23}Mg$. G.Parry, H.D.Scott and S.Swierszczewski.
Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 1024-7 (May, 1961).

Angular distributions of two alpha-particle groups from the reaction $Mg^{24}(He^3, \alpha)Mg^{23}$ at 5.5 MeV incident beam energy was measured by magnetic analysis. For both groups a peak is observed in the forward direction, but for one of the groups an additional peak is observed at large angles of observation. An attempt was made to explain the results in terms of a direct interaction mechanism.

Due to other Particles and Nuclei

9886 ELASTIC SCATTERING OF HEAVY IONS FROM SEVERAL GAS TARGETS.
E.Newman, P.G.Roll and F.E.Steigert.
Phys. Rev. (USA), Vol. 122, No. 6, 1842-8 (June 15, 1961).

The absolute differential cross-section for the elastic scattering of oxygen by gaseous targets of helium, nitrogen, and neon and of carbon by nitrogen were measured from about 4 to ~20 deg in the centre-of-mass system. The energy of the incident heavy ions was ~10 MeV per atomic mass unit. The ratio of the elastic cross-section to the Coulomb cross-section exhibits diffraction-like oscillations which damp out as $\eta = Z_1Z_2e^2/\hbar v$ increases from ~1 to ~4. The results are compared with the predictions of a simple diffraction model, a sharp-cutoff model, and a modified-cutoff model. Reasonably good agreement is obtained in predicting the angular position of the maxima and minima, but not the absolute cross-section. The modified-cutoff model appears to apply if η is greater than about 2.5. The value of r_0 found for the O^{16}—Ne scattering is 25% greater than for the remaining three reactions.

9887 AN INVESTIGATION OF SOME (t, d) REACTIONS IN LIGHT NUCLEI AT 5.5 MeV.
F. de S. Barros, P.D.Forsyth, A.A.Jaffe and I.J.Taylor.
Proc. Phys. Soc. (GB), Vol. 77, Pt 4, 853-65 (April, 1961).

A broad range magnetic spectrograph was used to analyse the deuterons emitted from targets of natural boron, carbon, silicon dioxide and aluminium bombarded with 5.5. MeV tritons. The angular distributions of the majority of the deuteron groups from the reactions observed in B^{10}, C^{12}, C^{13}, O^{16}, Al^{27} and Si^{28} were measured and information was also obtained on (t, d) reactions in Mg^{24}, Si^{28}, and Ca^{40} because of the presence of these nuclei as impurities in the targets. In all cases the measured excitation energies of the final nuclei are in good agreement with the accepted values. The angular distributions were compared with the stripping theory and also with published data on (d, p) transitions between the

e initial and final nuclear states. Where possible the ratios
e yields of corresponding (t, d) and (d, p) reactions were
pared with the predictions of stripping theory to extract values
e proportionality constant of the momentum transform of the
eron within the triton, $|A_0|^2 N_i^2$. The values obtained vary
een 18.0×10^{12} cm^{-1} for the transition from B^{10} to the ground
of B^{11} and 1.3×10^{12} cm^{-1} for the transitions from O^{16} to the
nd state of O^{17} and from Si^{28} to the 3.630 MeV excited state of
At 5.5 MeV triton bombarding energy, therefore, a constant
e of $|A_0|^2 N_i^2$ cannot be used to extract values of nucleon
ced widths from studies of (t, d) reactions.

clear Fission

9888 RESULTS OF THE PHYSICS OF NUCLEAR FISSION.
A.Kraut.
leonik (Germany), Vol. 2, No. 3, 105-28 (May, 1960). In German.
A wide collection of data and experimental results on fission.
ables, 21 figures and 480 references are given. See also Abstr.
of 1961.
C.G.Morgan

9889 THE ANGULAR CORRELATION OF PROMPT
NEUTRONS AND FISSION FRAGMENTS IN THERMAL
TRON FISSION OF U^{235}.
amanna, R.Chaudhry, S.S.Kapoor, K.Mikke, S.R.S.Murthy and
.Rama Rao.
lear Phys (Internat.), Vol. 25, No. 1, 136-51 (May, 1961).
The angular distributions of the prompt neutrons of specified
n energies emitted in the thermal neutron fission of U^{235} were
sured with respect to the direction of motion of light fragments.
ombination of a gridded ionization chamber and a gas scintilla-
counter system using xenon gas was used to measure the
rgy of the fission fragments as well as their direction of
ion relative to the electric field direction of the ionization
mber. A fast neutron detector was placed along the electric
d direction at a distance of 1 metre to measure the energy of the
mpt neutrons by time-of-flight technique. The distributions
ined are compared with the distributions computed on the
mption of isotropic emission of neutrons with a Maxwellian
ssion spectrum. It is shown that the laboratory anisotropy
)/N(90°) is an increasing function of the neutron energy in the
ratory system. The laboratory angular distributions are
sformed to obtain the centre-of-mass angular distributions
two groups of prompt neutron emission energies. Anisotropy of
form $(a + b \cos^2\theta)$ is indicated for prompt neutrons with
ssion energies greater than 1 MeV. Anisotropy of emission is
ussed in terms of the possibility of the fragments acquiring a
e angular momentum at the instant of scission.

890 THE KINETIC ENERGY OF Cs^{136} PRIMARY FRAGMENTS FROM FISSION OF U^{235}.
own and B.H.Oliver.
d. J. Chem., Vol. 39, No. 3, 616-27 (March, 1961).
The ranges of Cs^{136}, Cs^{137}, and Ba^{140} fission fragments in
inium were measured using an anodizing technique to strip
rs from the aluminium together with radiochemical methods to
rmine the fission products. The mean ranges are, in milligrams
square centimetre: Cs^{136}, 2.64; Cs^{137}, 2.91; and Ba^{140}, 2.82. The
e distributions were of near-Gaussian form with the following
entage full widths at half height: Cs^{136}, 17.7; Cs^{137}, 17.0; and
, 17.5. The range—energy relationship of Bohr, R ∝
$^{1/2}Z^{-2/3}$, was tested using the range data of Katcoff and of
y together with the kinetic energy data of Milton and Fraser
found to be accurate, within experimental error, over any
ed range of fragment masses. Using this formula it then
ars that the total kinetic energy in the fission mode leading to
is ~21 MeV less than normal.

891 DISTRIBUTION OF NUCLEAR CHARGE IN THE
PROTON-INDUCED FISSION OF Th^{232}. II.
elberg, H.Taniguchi and L.Yaffe.
d. J. Chem., Vol. 39, No. 3, 635-45 (March, 1961).
For Pt I, see Abstr. 1784 of 1959. The fractional chain yields
^{72}, Br^{82}, Ag^{112}, and La^{140}, formed in the proton-induced fission
^{232}, were measured at proton energies ranging between
and 82.4 MeV. The yields are compared with data previously
ned by others from uranium and thorium fission, and with
ictions made by Coryell. During the course of this investiga-
the half-life of Zn^{72} was checked and found to be 46.5±0.1
s, rather than 49 hours as previously reported.

9892 SEARCH FOR CORRELATIONS OF MOST PROBABLE NUCLEAR CHARGE Z_P OF PRIMARY FISSION FRAGMENTS WITH COMPOSITION AND EXCITATION ENERGY.
C.D.Coryell, M.Kaplan and R.D.Fink.
Canad. J. Chem., Vol. 39, No. 3, 646-63 (March, 1961).

The repartition of nuclear charge in fission has a narrower dispersion than almost any other property connected with the fission process. To a crude approximation, the distribution of nuclear charge between light and heavy partners L and H leads to the most probable charges $(Z_P)_L$ and $(Z_P)_H$ displaced from the respective charges Z_A of β-stability by the same amount for the two fragments. The existence of shell offsets in the Z_A versus A function for different neutron- and proton-shell regions must be considered. All available data for thermal fission $U^{235}(n_{th},F)$ are examined critically. The data show sudden offset-like drifts (fine structure) that may well be associated with shell properties of the products before the "neck" has dissolved. It is shown that these data eliminate naive equal charge displacement ECD (Glendenin, 1946), also an older competitive prescription of constant charge ratio CCR for the products, and an empirical Russian prescription (Apalin et al., 1960). The data are also examined in the light of the postulate that fission gives minimum nuclear plus coulombic potential energy (Present 1947, Fong 1955, Swiatecki—Blann 1960), and it is shown that the present mass formulae give too much uncertainty three to four β-decays from stability to give a useful test, but that shell effects in masses must be retained. Data from charged-particle fission with energy deposit up to 40-50 MeV are in reasonable accord with the low-energy data on correcting for composition and neutron boil-off. It is concluded from experiment that Z_P is a single-valued function of A, known to about ±0.15 unit for low-energy fission and ±0.25 unit for medium-energy fission, and that the fine structure very probably present is an indication of intrinsic nuclear chemistry.

Thermonuclear Reactions

9893 ESSENTIAL LIMITATIONS AND T—Nt DIAGRAM FOR SELF-SUSTAINING FUSION SYSTEMS. M.Imoto.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 1, No. 1-2, 19-30 (Oct., 1959).

The object of this paper is to show various criteria and essential limitations for any fusion reactor in a unified way. For this purpose, any fusion system is described in terms of two fundamental variables, a new parameter τ = Nt, called the reduced time, and the temperature T. Differential equations for time variations of the compositions of fuels, as well as the bremsstrahlung loss caused by electron—electron scattering, are newly introduced into the energy balancing considerations. As a result, maximum and minimum values of T and τ can be found, which are expressed as two contours enclosing energy balancing regions in narrow and wide senses in T—τ space, called the T—Nt diagram. These contours include the criteria of Post and Lawson. The T—Nt diagram is used to discuss the ideal temperature to operate reactors, upper limits to efficiencies for available energy gains, two roles played by ashes, the critical time to renew the fuel, the fact that, without effective utilization of neutrons and their energy, pure deuterium fuel cannot be used as a direct energy source, time variations of energy generation and losses, and some other criteria of a technical character. The T—Nt diagram can be regarded as a strategic chart for fusion projects.

NUCLEAR POWER STUDIES

9894 NUCLEAR POWER DEVELOPMENT IN THE UNITED STATES. F.K.Pittman.
Science (USA), Vol. 133, 1566-72 (May 19, 1961).

Review article.

9895 THE FLUX DENSITY OF THERMAL NEUTRONS IN THE VICINITY OF THE EDGE OF A SCATTERING MEDIUM.
M.Richter.
Ann. Phys. (Germany), Vol. 6, No. 3-4, 227-32 (1960). In German.

The flux density of thermal neutrons near the surface of hydrogenous moderators (paraffin and polythene) was measured, using the reactor in Rossendorf as a neutron source and Dy_2O_3 activation probes. These results confirm that, in this case, the exact theory (Abstr. 70 of 1959) is essentially close to the Fermi linear diffusion model. The results also give information on the anisotropy of scattering in the media.
D.H.Lord

ATOMIC AND MOLECULAR PHYSICS

ATOMS

9896 CANCELLATION OF KINETIC AND POTENTIAL ENERGY IN ATOMS, MOLECULES, AND SOLIDS.

M.H.Cohen and V.Heine.
Phys. Rev. (USA), Vol. 122, No. 6, 1821-6 (June 15, 1961).

In the energy levels of valence electrons in atoms, molecules, solids, and liquids, there is a contribution from the large negative potential energy inside the core of the atom and the large positive kinetic energy which the electron has there. Phillips and Kleinman have shown how the kinetic energy can be represented by a repulsive pseudopotential which cancels most of the potential energy inside the core. The explicit representation of the pseudopotential is now developed further to demonstrate more clearly the extent of the cancellation. The formalism justifies the simple models which are in common use for treating valence electrons. It is also used to relate similar atoms from different rows of the periodic table, and in particular to discuss the systematic trends in the energy levels of the alkali and noble metal atoms.

9897 CONFIGURATION INTERACTION IN SIMPLE ATOMIC SYSTEMS.

A.W.Weiss.
Phys. Rev. (USA), Vol. 122, No. 6, 1826-36 (June 15, 1961).

The ground-state wave-functions of the helium, lithium, and beryllium atoms were approximated by a superposition of configurations with expansion lengths ranging from 35 for helium to 55 for beryllium. The discrepancies in the total energy are 0.014 eV for helium, 0.026 eV for lithium, and 0.17 eV for beryllium. A 19-configuration function was also applied to the lowest ^3S state of helium, with a resulting accuracy of 0.0005 eV. The calculations were also made on all the isoelectronic series of ions through Z = 8, the discrepancy remaining of the same order of magnitude but increasing with increasing Z. A lower bound to the electron affinity of lithium is set at 0.4773 eV, with the most probable value, obtained by extrapolating the isoelectronic series, being placed at 0.62 eV.

9898 ON THE CALCULATION OF RADIAL WAVE FUNCTIONS CORRESPONDING TO ENERGIES IN THE CONTINUUM PART OF THE HELIUM SPECTRUM.

C.C.Grosjean and R.T.Van De Walle.
Nuovo Cimento (Italy), Vol. 19, No. 4, 696-722 (Feb. 16, 1961).

Describes the analysis leading to, and the numerical integration of, the differential equation for the radial wave-function for an ionized electron in the screened Coulomb field of the He^+ ion. The physical meaning of the approximation, and the computational details, particularly of normalization, are carefully discussed.

J.Hawgood

9899 STRUCTURE AND IONIZATION POTENTIAL OF Hf III AND Hf IV.

P.F.A.Klinkenberg, T.A.M. van Kleef and P.E.Noorman.
Physica (Netherlands), Vol. 27, No. 2, 151-2 (Feb., 1961).

Gives energies and J-values of three groups of levels (40 in all), transitions between which account for 80% of known Hf III lines, and of 8 levels of Hf IV. The ionization potentials are found to be 23.2 eV for Hf III and 33.3 eV for Hf IV.

J.Hawgood

9900 ATOMIC-BEAM INVESTIGATIONS OF ELECTRONIC AND NUCLEAR GROUND STATES IN THE RARE-EARTH REGION.

A.Y.Cabezas, I.Lindgren and R.Marrus.
Phys. Rev. (USA), Vol. 122, No. 6, 1796-1801 (June 15, 1961).

A number of radioactive nuclides in the rare earth region were investigated by using the atomic-beam magnetic-resonance technique. The total electronic angular momentun (J) and the atomic g-value (g_J) were determined for some low-lying levels in Pm, Dy, Ho, and Er. These observations are consistent with the following ground-state assignments: Pm I—$(4f)^5(6s)^2$, $^6H_{5/2}$; Dy I—$(4f)^{10}(6s)^2$, $^5I_8$; Ho I—$(4f)^{11}(6s)^2$, $^4I_{15/2}$; and Er I—$(4f)^{12}(6s)^2$, $^3H_6$. The ground-level assignments agree with the Hund's rule predictions, and the g values approximate the Landé values well. Present experimental knowledge concerning electronic ground states in the rare-earth region is summarized. The following nuclear spin values were obtained: Pm^{149}, $I = \frac{7}{2}$; Pm^{151}, $I = \frac{5}{2}$; Gd^{159}, $I = \frac{3}{2}$; Tb^{160}, $I = 3$; Dy^{165}, $I = \frac{7}{2}$; Dy^{166}, $I = 0$; 27 hr Ho^{166}, $I = 0$; Er^{169}, $I = \frac{1}{2}$; Er^{171}, $I = \frac{5}{2}$ and Tm^{171}, $I = \frac{1}{2}$. These values are compared with available beta-decay results. Most of these isotopes have large nuclear deformations, and the spin values are discussed in relation to the single-particle energy-level diagrams given by Nilsson. A few results are explained with the shell model.

9901 THEORY OF ZEEMAN EFFECT IN THE GROUND MULTIPLETS OF RARE-EARTH ATOMS.

B.R.Judd and I.Lindgren.
Phys. Rev. (USA), Vol. 122, No. 6, 1802-12 (June 15, 1961).

A number of corrections are made to the simple Landé formul for the g-values of levels deriving from the ground term of configurations of the type $4f^n$. These include (a) the Schwinger correction to give an accurate value of the gyromagnetic ratio for the electron spin; (b) a correction to allow for the deviations from perfect RS coupling; (c) a relativistic correction, which is directly related to the kinetic energy of the electrons; (d) a diamagnetic correction, depending on the electron density of the core. In order to calculate (b), the spin—orbit coupling constants and the Coulomb integrals F_k are estimated either from existing spectroscopic data or from a process of interpolation or extrapolation. An argument is presente for taking ratios of the integrals F_k corresponding to a hydrogenic eigenfunction. The various radial integrals required in the calculation of (c) and (d) are derived from a modified hydrogenic eigenfunction of the form $r^n e^{-ar} \cosh[\kappa(ar-n)]$. The parameter κ in this expression is estimated to be approximately 0.42 over the rare earth series by comparison with available Hartree self-consistent field eigenfunctions. The second parameter a is chosen to give a fit with the spin—orbit coupling constants. The result of calculati (a), (b), (c), and (d) is to give atomic g-values which agree remarkably well with the experimental data. This confirms that the grou configurations of Pr I, Nd I, Pm I, Sm I, Eu I, Dy I, Ho I, Er I, and T are of the type $4f^n$, and that such a configuration is very low-lying Tb I. Tables of spin—orbit coupling constants and $\langle r^{-3}\rangle$ for both neutral and triply ionized rare-earth atoms are given as well as o other radial integrals.

9902 THE QUADRUPOLE MOMENTS OF THE COPPER ISOTOPES AND THE HYPERFINE STRUCTURE OF THE $3d^94s^2m\,^2D-3d^{10}4p\ ^2P$ TRANSITION IN THE COPPER - I SPECTRUM.

W.Fischer.
Z. Phys. (Germany), Vol. 161, No. 1, 89-98 (1960). In German.

The hyperfine structures of these lines at 5782 and 5700 A. were observed photographically with a Fabry—Perot etalon and using pure isotopes 63 and 65. The quadrupole moments were calculated to be 0.20 and 0.19 × $10^{-24}cm^2$, respectively, in agreement with Bleaney's paramagnetic resonance measurements (Abstr. 2890 of 1955).

G.F.Lothian

9903 THE QUADRUPOLE MOMENTS OF THE COPPER ISOTOPES AND THE HYPERFINE STRUCTURE OF THE $3d^94s^2m\,^2D-3d^{10}4p\,^2P$ TRANSITION IN THE COPPER-I SPECTRUM.

W.Fischer.
Z. Phys. (Germany), Vol. 162, No. 4, 400-1 (1961). In German.

An addendum to an earlier paper (see preceding abstract). When the procedure of Schwartz (Abstr. 3010 of 1955) is used to analyse the data in terms of A- and B-factors, and a further C-factor taking account of the nuclear octupole moment, the values of the B- and C-factors derived from the author's work differ from those derived from measurements by Kaliteevskii and Chaika [Optika i. Spektrosk (USSR), Vol. 1, No. 5, 606 (1956); Izv. Akad. Nauk SSSR, Ser. fiz. Vol. 22, No. 6, 692 (1958)]. It is claimed that the C-factors from the latter measurements are much too great to be real.

J.Sheridan

9904 OPTICAL ANISOTROPY OF A METAL VAPOUR IN THE NEIGHBOURHOOD OF AN ABSORPTION LINE.

A.Omont and J.Brossel.
C.R. Acad. Sci. (France), Vol. 252, No. 5, 710-12 (Jan. 30, 1961). In French.

Discusses properties of anisotropic absorption of a metal vapour in the region of a spectral line when in a magnetic field.

R.W.Nicholls

05 ULTRA-VIOLET EXTENSIONS OF THE ARC SPECTRA OF THE ALKALINE EARTHS: THE ABSORPTION
TRUM OF MAGNESIUM VAPOUR. K.Codling.

Phys. Soc. (GB), Vol. 77, Pt 3, 797-800 (March, 1961).

he principal series of magnesium was photographed, in
ption, in the ultraviolet region between 2400 A and 1600 A
ans of a 3 metre vacuum spectrograph and a large King
ce. Measurement of 24 new members of the series against
ate copper standards leads to a revised value of 61670.6 cm^{-1}
e ionization potential of MgI, an increase of 1.5 cm^{-1} on the
previously accepted.

906 COHERENT MULTIPLE DIFFUSION OF THE OPTICAL RESONANCE LIGHT OF THE 6^3P_1 LEVEL OF
CURY IN A STRONG MAGNETIC FIELD. A.Omont.

Acad. Sci. (France), Vol. 252, No. 6, 861-3 (Feb. 6, 1961).
ench.

theoretical treatment is given of the coherent multiple
ion of Hg(2537A) photons, their imprisonment time, and their
rofile in a magnetic field strong enough to separate the
an sublevels. R.W.Nicholls

07 HYPERFINE STRUCTURE AND ISOTOPE SHIFTS IN THE 2537 A LINE OF MERCURY. W.G.Schweitzer, Jr.

. Soc. Amer., Vol. 51, No. 6, 692-3 (June, 1961).

he position of the components in natural mercury are given
ve to the 198 component. In two cases the hyperfine splitting is
ared with that obtained by direct measurements.
G.H.C.Freeman

908 A "LEVEL CROSSING" EXPERIMENT IN MERCURY. J.N.Dodd.

. Phys. Soc. (GB), Vol. 77, Pt 3, 669-72 (March, 1961).

A change of the intensity of resonance fluorescence may take
when Zeeman states of the excited level have the same energy.
ields at which these "level crossings" occur in Hg^{199} and
were measured. Combined with recent determinations of the
rfine coupling constants, the results yield values for g_J of
P_1 states: g_J (199) = 1·48634 ± 0·00005, g_J (201) = 1·48606 ±
0015.

909 SOME ISOTOPIC SHIFTS IN THE SPARK SPECTRUM OF Te. R.H.Hughes, W.A.Hilton and F.A.Sharpton.

t. Soc. Amer., Vol. 51, No. 6, 696 (June, 1961).

The isotope shifts in the 4049 A line of Te II were measured
nriched samples of Te^{124}, Te^{126} and Te^{128}. The results corres-
closely to those of Kuhn and Turner [Bull. Amer. Phys. Soc.,
3, 414 (1958)]. G.H.C.Freeman

910 THE POSITION DEPENDENCE OF COLLISION INDUCED SATELLITES OF ALKALI LINES ON THE NATURE OF
ALKALI. Shang Yi Ch'en and R.A.Wilson, Jr.

ca (Netherlands), Vol. 27, No. 5, 497-508 (May, 1961).

he dependence of the positions of both the red and the violet
ite bands of alkali lines on the nature of alkalis was investi-
from the microphotometer traces of over 100 satellites of the
ption lines of Li, Na, K, Rb and Cs in the presence of He, Ne,
r, and Xe. It was found that for a given foreign gas, the abso-
nagnitudes of satelitte-line separation, $|\Delta v|$ in cm^{-1}, for both
nd violet satellites decreased with increasing atomic weights
alkalis; while for a given alkali, $|\Delta v|$ increased with the
c weights of the foreign (perturbing) gas for red satellites but
ased for violet satellites. Red satellites were observable
or heavy gases (Kr and Xe). The red satellite separation had
k value for the third member of Li and for the second member
er alkali absorption series. Violet satellite separations were
large for the resonance lines but decreased so rapidly for the
r members that no satellites were resolved for the second or
r members of the principal series for the heavy gases (Kr and
For a given foreign gas, the red satellite separation for the
wave length component ($^2P_{1/2}$) of the doublet decreased, while
or the short wavelength component ($^2P_{3/2}$) increased with the
c weight of the alkalis.

11 SELECTIVE PRESSURE BROADENING OF Si AND F SPECTRAL LINES. M.B.K.Sarma.

Phys. Soc. (GB), Vol. 77, Pt 3, 665-8 (March, 1961).

he behaviour of the Si I, II, III and IV and F II and III spectral
n highly condensed discharges, in the range 2900—6000 A, at
ires varying from 3 mm to 35 cm, is given. The lines origi-
from the higher energy levels are found to be more sensitive
ssure.

9912 ON THE IDENTIFICATION OF THE K_α SATELLITES. I. LS REGION. Z.Horák.

Proc. Phys. Soc. (GB), Vol. 77, Pt 5, 980-6 (May, 1961).

The lines α'', α', α_3, α_3', α_4 in the spectra of neon and a few of its neighbours ($10 \leq Z \leq 14$) are identified as $K^{-1}L^{-1} \rightarrow L^{-2}$ transitions. For this purpose the case Z = 10 was analysed using earlier self-consistent-field results together with optical term values and intensity considerations. The necessary Z-dependences were developed by means of Layzer's theory (1959).

9913 THE ISOTOPE SHIFT BETWEEN THE EVEN ISOTOPES OF Sr 84, 86, 88, AND 90 AND THE DISCONTINUITY IN THE NUCLEAR VOLUME EFFECT AT THE NEUTRON NUMBER 50. K.Heilig.

Z. Phys. (Germany), Vol. 161, No. 3, 252-66 (1961). In German.

It is found that the isotope shift of the stable isotopes 84, 86, 88 and 90 has the sign of the nuclear mass effect whereas the shift between the isotopes 88 and 90 has the sign of the volume effect. The isotope locations in the Sr II resonance lines are at (84) −12.4 ± 0.5; (86) 5.8 ± 0.3; (88) 0; (90) −11.4 ± 1.2 in units of 10^{-3} cm^{-1}. Corresponding locations exist in the Sr I resonance line. It is further confirmed that the volume effect at N = 50 is of the same order of magnitude as that at N = 82. S.J.St-Lorant

9914 MEASUREMENT OF THE g_J-FACTORS OF ALKALI ATOMS BY MEANS OF ELECTRON PARAMAGNETIC RESONANCE. D.Conrad

Z. Phys. (Germany), Vol. 162, No. 2, 160-8 (1961). In German.

Magnetic dipole transitions of Na^{23}, K^{39}, Rb^{85}, Rb^{87} and Cs^{133}, between Zeeman components of hyperfine structure terms ($\Delta F = \pm 1$) for the $^2S_{1/2}$ ground states, were observed in absorption in a paramagnetic resonance spectrometer. Resonances at 9450 Mc/s occurred at static fields between 1 and 5 kG. The method of vaporizing the metals in ampoules in the measuring cavity is detailed. The g_J-factors were separately determined for each of the 23 transitions measured. For Na and K, agreement with theory and with atomic beam measurements was obtained. The new value for Rb^{85} lies closer to the theoretical value than earlier figures. For Rb^{87} and Cs^{133} the values differ from the theoretical ones. A proven difference between the g_J-values of Rb^{85} and Rb^{87} must be attributed to differences in nuclear properties. J.Sheridan

9915 NEW PROCESS OF EXCITATION TRANSFER IN HELIUM. R.M.St John and R.G.Fowler.

Phys. Rev. (USA), Vol. 122, No. 6, 1813-20 (June 15, 1961).

Precise observations have been made on light emission from low triplet levels of helium gas traversed by a monoenergetic electron beam, with varying helium pressure and electron energy. In the past it has been customary to assign this triplet excitation to direct transfer from ^1P states in flagrant violation of the Wigner rule and seemingly excessive cross-sections for the transfer have been inferred. A new process of excitation transfer is proposed which minimizes the conflict with the Wigner rule by reducing the sizes of the cross-sections required to values close to the gas-kinetic cross-section. It is hypothesized than many ^1P states, including those with large quantum number n, transfer excitation energy to neighbouring triplet states having closely corresponding principal quantum numbers. The triplet states thus formed in turn populate low-level triplet states by radiative transitions. It is found that states lying between n = 4 and n = 15 would play the dominant role in the transfer process. Statisfying qualitative explanations of several additional excitation-transfer-process phenomena are derived from this new multiple-state-transfer process.

9916 ELASTIC SCATTERING OF SLOW ELECTRONS BY HELIUM ATOMS. B.L.Moiseiwitsch.

Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 721-3 (March, 1961).

The scattering length for elastic collisions between electrons and helium atoms is calculated with full allowance for distortion and exchange by the exact numerical integration of the appropriate integro-differential equation for the zero-order partial wave. The resulting cross-section $26a_0^2$ for electrons of zero impact energy is in good agreement with the available experimental data, so that the effect of polarization which is neglected in the present calculation is probably small.

9917 THE ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY HYDROGEN ATOMS.

A.E.Kingston and B.G.Skinner.

Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 724-8 (March, 1961).

The expression for the differential cross-section obtained from the second Born approximation by including only terms to the third order in the interaction energy is employed to calculate the differential and total cross-sections for the elastic scattering of electrons and positrons by hydrogen atoms. Allowance is made for both distortion and polarization by evaluating the terms which correspond to transitions through the 1s, 2s and 2p intermediate states. It is found that for electrons with impact energies below 100 eV the effect of distortion and polarization is to increase the total cross-section appreciably above the first Born cross-section. For positrons, distortion and polarization decrease the total cross-section.

9918 POLARIZATION AND THE TRIPLET ELECTRON—HYDROGEN SCATTERING LENGTH. A.Temkin.
Phys. Rev. Letters (USA), Vol. 6, No. 7, 354-5 (April 1, 1961).

Preliminary results of an accurate calculation of the effects of polarization on scattering length (~ 10%) and of the scattering length itself (1.74) are reported. R.W.Nicholls

9919 ENERGY LOSSES OF 25 keV ELECTRONS IN ATOMIC HYDROGEN. H.Boersch, J.Geiger and H.J.Reich.
Z. Phys. (Germany), Vol. 161, No. 3, 296-309 (1961). In German.

Describes experiments in which a beam of 25 keV electrons was shot through a hydrogen stove maintained at 2800° K to form atomic hydrogen. The energy losses of the scattered beam were measured and compared with the predictions of Bethe's theory of scattering in atomic hydrogen. The discrete energy loss at 10.17 eV agrees within the limit of experimental error. The observed higher energy losses also agree well after a correction has been made for the state of partial dissociation of the hydrogen. A.E.I.Research Laboratory

PRODUCTION OF NEGATIVE IONS IN ATOMIC COLLISIONS.
See Abstr. 9526

FORMAL THEORY OF REARRANGEMENT COLLISIONS.
See Abstr. 9327

Isotopes

9920 AN ELECTROSTATIC-MAGNETIC SEPARATOR FOR OBTAINING ISOTOPES OF HIGH PURITY.
F.A.White, F.M.Rourke, J.C.Sheffield and L.A.Dietz.
IRE Trans nuclear Sci. (USA), Vol. NS-8, No. 2, 13-21 (April, 1961).

The design of a 30 in. radius combined velocity and direction focusing mass analyser is described. Application of this instrument as a high purity isotopic separator for research in nuclear physics, metallurgy, and semiconductors is also discussed. Brief mention is made of the development of p—n junctions for the detection of singly-charged ions of low kinetic energy.

Mesic Atoms

9921 ON THE μ-MESONIC ATOMS.
Y.Eisenberg and D.Kessler.
Nuovo Cimento (Italy), Vol. 19, No. 6, 1195-1210 (March 16, 1961).

In an attempt to get a deeper insight into the problem of the "missing X-rays" in the capture of μ-mesons in the light elements, a complete cascade calculation of the μ-meson transitions in the mesonic atom was conducted. The results indicate again that the calculated K X-ray yields below Z = 6 and the L X-ray yields below Z = 14 are much above the experimental values. As was noted before by other authors, the deficiency of X-rays increases linearly with decreasing quantum energy between about 90 keV and 20 keV. The experimental yields agree with the calculations above 90 keV, and are lower than the calculated values, by a factor of about 5, at 20 keV. Good agreement between the calculations and experiment is obtained, however, for the (approximately energy-independent) ratios of the higher to basic X-ray yields, provided that a proper choice of the initial meson distribution is made. A comparison between the calculated Auger electron yields and the experimental results for μ^--capture in nuclear emulsions seems to indicate that the "mixed" Auger-radiative transitions introduced by Ruderman are indeed effective (apparently close to 100%) in the de-excitation of the metastable 2s level in the elements C, N, O, in nuclear emulsion. If this mixed transitions play the same role also in the lightest elements (Li, Be, B), the problem of the "missing" X-rays becomes more serious than before. The expected Auger electron spectrum for μ^--capture in the heavy elements (AgBr) of nuclear emulsion has also been calculated.

MOLECULES

9922 POTENTIAL CONSTANTS OF CERTAIN PLANAR XY_2Z MOLECULES.
P.Babu Rao and K.Sreeramamurty.
Current Sci. (India), Vol. 29, No. 12, 467-8 (Dec., 1960).

The force constants and interatomic distances of CH_2O, CD_2O, CF_2O, CCl_2O, BF_2Cl, and BBr_2Cl are evaluated and tabulated. G.I.W.Llewely

9923 POTENTIAL FUNCTIONS OF MOLECULES OF THE SERIES $(CH_3)_nSiCl_{4-n}$ (n = 1 – 4). I.F.Kovalev.
Dokl. Akad. Nauk SSSR, Vol. 136, No. 6, 1313-16 (Feb. 21, 1961).
In Russian.

Results are tabulated of a calculation of the "force coefficients" and "influence coefficients" for these molecules, from experimenta spectra. Some specific features of the forces are discussed. [English translation in: Soviet Physics—Doklady (USA)]. D.W.L.Sprun

9924 APPLICATION OF THE REDUNDANCY RELATIONSHIPS BETWEEN FORCE CONSTANTS. R.L.Hubbard.
J. Molecular Spectrosc. (USA), Vol. 6, No. 2, 272-4 (Feb., 1961).

It is pointed out that many force fields violate the redundancy constraints. A method for adjusting force constants to these conditions is given. W.J.Orville-Thomas

9925 THE FUNDAMENTAL VIBRATION FREQUENCIES OF CALOMEL. A.Hadni, C.Henry, J.P.Mathieu and H.Pou
C.R. Acad. Sci. (France), Vol. 252, No. 11, 1585-6 (March 13, 1961)
In French.

Measurements of the absorption and Raman spectra of Hg_2Cl_2 are reported. It is claimed that the lines observed are in general agreement with those expected though one (of six) is left unaccounted for. Values are deduced for the molecular force constants. J.W.Leec

9926 ROTATIONAL—TRANSLATIONAL RELAXATION TIM IN H_2 CALCULATED FROM THERMAL CONDUCTIVI
B.N.Srivastava and A.K.Barua.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 677-81 (March, 1961).

An approximate method was developed for obtaining the value of Z, the number of collisions required to make a rotational—translational energy transfer in a diatomic gas from the thermal conductivity data, and the geometry of the apparatus employed in the conductivity measurements. The values of Z for H_2 calculated at different temperatures are in fair agreement with the values obtained by other methods. They also show that Z increases with rise of temperature.

9927 EXCITATION OF THE FIRST NEGATIVE SYSTEM OF O_2^+ BY A PROTON BEAM IN AIR AND OXYGEN.
L.Herman, H.I.S.Ferguson and R.W.Nicholls.
Canad. J. Phys., Vol. 39, No. 3, 476 (March, 1961).

A preliminary report is made of the excitation of the $\Delta v = -1, 0, 1$ sequences of O_2^+ first negative bands in 40 keV proton beams in O_2 over the pressure range of 10^{-1} to 10^{-3} mm Hg. R.W.Nicholls

MICROWAVE SPECTRUM, STRUCTURE AND HINDERED INTERNAL ROTATION OF DIMETHYL SULFIDE. See Abstr. 969

9928 MICROWAVE SPECTRUM OF ETHYL IODIDE. II.
T.Kasuya.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1273-7 (July, 1960).

For Pt I see Abstr. 7463 of 1961. The potential barrier which hinders the internal rotation in the ethyl iodide molecule was studied. If the potential energy is assumed to be of the sinusoidal form $\frac{H}{2}(1-\cos 3x)$, the barrier height is determined as $H = 3.22 \pm 0.5$ kcal/mole from the Q^b-type transition in the first excited torsional state. The torsional frequency is about 230 cm^{-1}. The effect of internal rotation on the quadrupole hyperfine structure of K = 1 levels was analysed.

9929 MICROWAVE SPECTRUM OF METHYL MERCAPTAN.
T.Kojima.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1284-91 (July, 1960).

Two new series of $\Delta J = 0$ transitions in the first excited torsional state as well as one series of the S^{34} isotopic molecule were found in the range up to 37 Gc/s besides those reported in the previous paper(see Abstr. 6391 of 1958). The two series in the

t excited torsional state are discussed, confirming the potential
rier height $V_3 = 443.9 \pm 1.0\ \mathrm{cm}^{-1}$ which were determined from
= ±1, $\Delta K = \mp 1$ lines in the ground torsional state. Moreover,
hindering potential is considered to be sinusoidal with an
uracy better than 1%.

9930 THE l-TYPE DOUBLETS OF ISOTOPIC HCN MOLECULES. T.Törring.
Phys. (Germany), Vol. 161, No. 2, 179-89 (1961). In German.

Direct l-type doublet transitions in the range 6.5 to 26 Gc/s
e measured for the first excited levels ($v_2 = 1$) of the bending
ational mode of $H^{13}C^{14}N$, $H^{12}C^{15}N$, $D^{13}C^{14}N$ and $D^{12}C^{15}N$, at the
ural concentrations of these C and N isotopes. The values of q,
measured frequencies divided by $J(J + 1)(v_2 + 1)$ where J is the
tional quantum number, are expressed as $q_0(\mathrm{Mc/s}) - a\,J(J+1)$; for
species in the order given, q_0 is: 107.419, 105.970, 91.147 and
40 Mc/s; corresponding values of a being 1.22, 1.21, 1.04 and
kc/s. From new and earlier measurements on $H^{12}C^{14}N$ and
^{14}N, the respective values of q_0 are 112.239 and 93.096 Mc/s;
responding values of a being 1.333 and 1.10 kc/s. Values of q_0
ulated according to the theory of Nielsen [Phys. Rev. (USA),
78, 296 (1950)], but using frequencies for vibration of infinite-
al amplitude and equilibrium rotational constants, are all some
below these figures. Deviations in the observed direction are
ected from errors due to anharmonicity of the vibration and
endence of the rotational constant on the vibrational state. Values
agree with the theory of Nielsen and Amat [J. Phys. Radium
ance), Vol. 15, 601 (1954)]. From frequency and intensity
surements at temperatures up to 300° C, similar l-type doublet
sitions are identified for the $v_2 = 3$ and $v_2 = 5$ states of $H^{12}C^{14}N$
$D^{12}C^{14}N$. For the $v_2 = 3$ data, q is expressed as $q_0 + q_0'(v_2 + 1) -$
$J(J + 1) - b\,J^2(J + 1)^2$. For the species in the order named,
es of q in this are 108.921 and 90.735 Mc/s; corresponding
es of q_0' being 1.659 and 1.1805 Mc/s. These q_0 values now
e with those calculated, within the errors due to uncertainties
onstants used in the calculation. The term in $J^2(J + 1)^2$ shows
rly outside the errors of measurement; b for HCN is about
's and that for DCN about 12 c/s, a retaining its earlier values.
values of q for $v_2 = 5$ show strong dependence on J; their
ression will probably require terms in higher powers of $J(J + 1)$
a term $q_0''(v_2 + 1)^2$, but any changes necessitated in q_0 and q_0'
be small. J.Sheridan

9931 THE VISIBLE SPECTRUM OF THE MOLECULE AuCa. J.Schiltz.
. Acad. Sci. (France), Vol. 252, No. 12, 1750-2 (March 20, 1961).
rench.

Absorption bands observed in a King furnace at 1600° to
)° C are assigned to AuCa. The bands are degraded to the violet.
stants for three states are as follows:

	T_{00}	ω_e	$x_e\omega_e$
B	15 024.05	219	5
A	14 284.7	219	5
X	0	221.8	2

R.F.Barrow

9932 A $^1\Sigma^-$-$^3\Pi_r$ SPECTRUM OF SiO. R.D.Verma and R.S.Mulliken.
ad. J. Phys., Vol. 39, No. 6, 908-16 (June, 1961).

A new $^1\Sigma^-$-$^3\Pi_r$ (case a) spectrum is identified in the region
)-4300 A for the SiO molecule. The rotational analysis of the
ctrum gives the following constants for the lower and upper
es in cm^{-1}:

$$B_0' = 0.6801_2 \quad D_0' = 1.7 \times 10^{-6}$$
$$B_0'' = 0.6765_6 \quad D_0'' = 1.4 \times 10^{-6} \quad A = 72.55 \pm 0.015.$$

scussion of electron configurations is given.

CANCELLATION OF KINETIC AND POTENTIAL ENERGY IN
ECULES. See Abstr. 9896

9933 THE $^2\Sigma_u^+ \leftrightarrow {}^2\Sigma_g^+$ TRANSITION IN H_2^-. B.K.Gupta.
sica (Netherlands), Vol. 26, No. 5, 335-6 (May, 1960).

The oscillator strength of the $^2\Sigma_u^+ \leftrightarrow {}^2\Sigma_g^+$ transition of H_2^- has
computed approximately at four internuclear separations
a_0, $5.25a_0$, $5.6a_0$, $6.3a_0$, and found to be respectively 0.184, 0.180,
5, 0.165. R.W.Nicholls

9934 ENERGIES OF EXCITED ELECTRONIC STATES AS CALCULATED WITH THE ZERO DIFFERENTIAL OVERLAP APPROXIMATION. J.N.Murrell and L.Salem.
J. chem. Phys. (USA), Vol. 34, No. 6, 1914-15 (June, 1961).

It is shown that electronic excitation energies, calculated using the zero differential overlap approximation, can always be expressed in terms of the difference between two-electron Coulombic integrals. These differences can then be used as empirical parameters for the calculation of excitation energies.

9935 OPEN- AND CLOSED-SHELL S.C.F. METHOD FOR CONJUGATED SYSTEMS. O.W.Adams and P.G.Lykos.
J. chem. Phys. (USA), Vol. 34, No. 4, 1444-5 (April, 1961).

Roothaan's theory for open-shell configurations (Abstr. 17807 of 1960) is applied to trans-butadiene in which an $sp^2\pi$ nitrogen atom is substituted for a terminal $sp^2\pi$ carbon atom. The results for the singlet ground state and for the lowest triplet state are given.
T.E.Peacock

9936 ESTIMATION OF THE INFLUENCE OF FOREIGN ATOMS IN THE CORE OF CONJUGATED BONDS ON THE SPECTRUM AND THE CHARGE DISTRIBUTION IN THE MOLECULE. W.Woźnicki and S.Kwiatkowski.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys. (Poland), Vol. 9, No. 1, 39-42 (1961).

FEMO calculations, taking into account the influence of foreign atoms in the core, were carried out for pyridine and pyrimidine. Theoretical estimates for the absorption bands and bond orders are given. W.J.Orville-Thomas

9937 BOND LENGTHS AND BOND ANGLES IN OCTAHEDRAL, TRIGONAL-BIPYRAMIDAL, AND RELATED MOLECULES OF THE NON-TRANSITION ELEMENTS. R.J.Gillespie.
Canad. J. Chem., Vol. 39, No. 2, 318-23 (Feb., 1961).

The stereochemistry of molecules in which there are five or six pairs of electrons in the valency shell of a central atom is discussed in terms of the repulsions that exist between pairs of electrons in the valency shell as a consequence of the operation of the Pauli exclusion principle. An explanation is given for the difference in lengths of the axial and equatorial bonds in molecules such as PCl_5 and ClF_3 whose structures are based on the trigonal-bipyramidal arrangement of five valency-shell electron pairs. The fact that in molecules with a central atom with a valency shell of six electron pairs, one of which is a lone pair and which have the structure of a square pyramid, the central atom always lies below rather than in, or above, the base of the square pyramid, is also accounted for.

9938 SOME ASPECTS OF ELEMENTAL SULPHUR. A STUDY BY MEANS OF THE SEMI-EMPIRICAL MO-LCAO METHOD. G.Bergson.
Ark. Kemi (Sweden), Vol. 16, Paper 29, 315-26 (1960).

Semi-empirical LCAO-MO calculations are carried out on elemental sulphur in the forms S_6, S_8, and S_n (sulphur chains). A torsion energy function is defined and the energies for various conformations calculated. For a chain of n sulphur atoms the most stable conformation corresponds to a dihedral angle $\phi = 90°$. For the S_6 and S_8 molecules it is shown that the torsion energy for S_6 is approximately four times that of S_8; this explains the greater stability of S_8 ($\phi = 99°$) compared with S_6 ($\phi = 69°$).
W.J.Orville-Thomas

9939 GROUND-STATE WAVE FUNCTIONS FOR LINEAR MOLECULES. E.Clementi.
J. chem. Phys. (USA), Vol. 34, No. 4, 1468-9 (April, 1961).

Reports results of LCAO-MO-SCF calculations on C_3, N_3^-, NO_2^+ and HF_2^-, using 1s, 2s and 2p Slater-type AO's. J.Hawgood

9940 QUANTUM MECHANICS OF MOBILE ELECTRONS IN CONJUGATED BOND SYSTEMS. I. GENERAL ANALYSIS IN THE TIGHT-BINDING FORMULATION. K.Ruedenberg.
J. chem. Phys. (USA), Vol. 34, No. 6, 1861-77 (June, 1961).

The quantum-mechanical treatment is carried through for a set of electrons in a homonuclear conjugated bond system of arbitrary size, including electronic interaction and including all overlap effects between neighbours. All framework contributions are obtained by explicit integration over the framework Hamiltonian, including the effect of nonconjugated neighbour atoms and differentiating between different types of conjugated atoms (joint, nonjoints, etc.). Expressions are given for the ground-state energy, ionization potential, electron affinity, electronegativity, and for the configuration interaction matrix for the calculation of excited states, assuming singly excited configurations. The results take simple forms permitting instructive interpretations. The partial additivity of one-electron binding-energy contributions, obtained as eigenvalues of topological molecular orbitals, and the approximate validity of the "neglect of differential overlap" is proved.

9941 QUANTUM MECHANICS OF MOBILE ELECTRONS IN CONJUGATED BOND SYSTEMS. II. AUGMENTED TIGHT-BINDING FORMULATION.

K.Ruedenberg.

J. chem. Phys. (USA), Vol. 34, No. 6, 1878-83 (June, 1961).

The analysis of homonuclear conjugated systems, which is given within the limits of the tight-binding approximation in Pt I, is extended to include the interactions between non-neighbour atoms and the variation in the interactions between neighbour atoms. Both kinds of interactions are included as perturbation effects on the tight-binding approximation. As a consequence, the formalism developed for the latter is not being complicated and the interpretations remain unchanged. Application to benzene and naphthalene illustrates the approach.

9942 QUANTUM MECHANICS OF MOBILE ELECTRONS IN CONJUGATED BOND SYSTEMS. III. TOPOLOGICAL MATRIX AS GENERATRIX OF BOND ORDERS.

K.Ruedenberg.

J. chem. Phys. (USA), Vol. 34, No. 6, 1884-91 (June, 1961).

It is shown that in homonuclear conjugated systems the various bond orders and similar quantities can be written as matrix functions of the topological incidence matrix. This entails the existence of a number of useful general relations between these various quantities. The relations include as special cases: Coulson and Rushbrooke's theorem on charge orders in alternants; Hall's theorem on bond orders in alternants; McWeeny's theorem on the formal charges; Ham and Ruedenberg's correlation between Coulson and Mulliken bond orders for neighbours in alternants; closely related is Ham—Ruedenberg—Platt's relation between valence-bond bond orders and molecular orbital theory. A number of new relations between bond orders are derived and discussed. The generalization from alternants to nonalternants is given particular attention.

9943 QUANTUM MECHANICS OF MOBILE ELECTRONS IN CONJUGATED BOND SYSTEMS. IV. INTEGRAL FORMULAS.

K.Ruedenberg.

J. chem. Phys. (USA), Vol. 34, No. 6, 1892-6 (June, 1961).

Formulae are established for all carbon and hydrogen penetration integrals occurring in the tight-binding approximation of the theory of mobile electrons. The orbital exponents of the penetrated shielding orbitals may differ from the orbital exponent of the penetrating 2pπ electrons. A simple correlation between kinetic energy integral and overlap integral is found.

9944 QUANTUM MECHANICS OF MOBILE ELECTRONS IN CONJUGATED BOND SYSTEMS. V. EMPIRICAL DETERMINATION OF INTEGRALS BETWEEN CARBON ATOMIC ORBITALS FROM EXPERIMENTAL DATA ON BENZENE.

K.Ruedenberg and E.M.Layton, Jr.

J. chem. Phys. (USA), Vol. 34, No. 6, 1897-1907 (June, 1961).

It is shown that the experimental information given in the ultraviolet spectrum of benzene uniquely determines the two-centre Coulomb integrals between the 2pπ atomic orbitals of carbon as a function of the internuclear distance. The calculations are carried out including all terms involving neighbour overlap. For the many-centre electron-interaction integrals, the Mulliken approximation and the London approximation are both considered with little difference in the results. Some peculiar properties of the empirically determined distance dependence are compared with the theoretical behaviour of two-centre Coulomb integrals. The empirical values for the resonance integral and the Coulomb integral are also found. The investigation differs from similar work of Pariser by the inclusion of overlap effects.

9945 QUANTUM MECHANICS OF MOBILE ELECTRONS IN CONJUGATED BOND SYSTEMS. VI. THEORETICAL EVALUATION OF ENERGY CONTRIBUTIONS.

K.Ruedenberg.

J. chem. Phys. (USA), Vol. 34, No. 6, 1907-13 (June, 1961).

The general formulae of Pt I are used to analyse the energy contributions of the molecular framework of a π-electron system in detail, without use of additional assumptions. The valence-state potential of carbon, used in the framework potential, and the 2pπ atomic orbitals are determined by a minimum principle. The Coulomb integral and resonance integral are evaluated from their constituent integrals in the tight-binding approximation. The agreement with the empirical values is unsatisfactory for the Coulomb integral but very good for the resonance integral. The approximate proportionality between energy matrix elements and overlap integrals is proven for a variation of the internuclear distance between 1.26 and 1.54 A.

9946 POTENTIAL CURVES FOR DOUBLY POSITIVE DIATOMIC IONS.

A.C.Hurley and V.W.Maslen.

J. chem. Phys. (USA), Vol. 34, No. 6, 1919-25 (June, 1961).

An integral form of the quantum-mechanical virial theorem, applicable to ionic as well as neutral systems, is established. This theorem is used to derive an approximate expression for the potential curve for a doubly positive diatomic ion in terms of the corresponding curve for a related neutral molecule. The appearance potentials of a number of these ions are calculated and compared with values obtained from electron-impact measurements. Satisfactory agreement is found, but a crucial test of the theory is vitiated by uncertainties in the experimental value of either the appearance potential of the doubly charged ion or the dissociation energy of the corresponding neutral molecule. The accuracy of the approximations underlying the theory is estimated by a series of calculations on two-electron systems.

9947 A CALCULATION OF THE POTENTIAL ENERGY CURVES FOR SOME ELECTRONIC STATES OF CARBON MONOXIDE.

H.Lefebvre-Brion, C.M.Moser and R.K.Nesbet.

J. chem. Phys. (USA), Vol. 34, No. 6, 1950-7 (June, 1961).

The LCAO-MO SCF orbitals for the $^1\Sigma^+$ ground state of carbo monoxide, constructed from 1s, 2s, and 2p atomic functions, are calculated for 11 internuclear distances between 1.5 and 4.0 a.u. Using the unoccupied SCF orbitals a number of lower excited stat are calculated. The equilibrium distances, force constants, and ν_{00} energies are calculated from the curves of E versus R for these various states. As these calculated curves do not separate at infinity into the atoms in their proper spectroscopic states, config ration interaction is carried out with functions which cross the computed curves and separate into the atoms in their ^3P states. The lower states of carbon monoxide seem to be divided into three classes: (a) those which are reasonably well represented by the functions, namely, X $^1\Sigma^+$, e $^3\Sigma^-$, a' $^3\Sigma^+$, A $^1\Pi$, and a $^3\Pi$; (b) those which are not at all well represented by the functions, namely, b $^3\Sigma^+$, B $^1\Sigma^+$, and C $^1\Sigma^+$; (c) those states for which the experimen assignment may be in error, namely, d $^3\Pi$ and F $^1\Pi$.

9948 THEORY OF THE DIAMAGNETIC SUSCEPTIBILITIES OF THE ALKANES.

H.F.Hameka.

J. chem. Phys. (USA), Vol. 34, No. 6, 1996-2000 (June, 1961).

A general theory of the diamagnetic susceptibilities of the alkanes is developed. It is found that the molecular susceptibilitie are obtained as sums of contributions from the 1s electrons of the carbon atoms, from the various C—C and C—H bonds, and from interactions between various pairs of adjacent C—C and C—H bond It is possible to express the theory in a semi-empirical form so that all susceptibilities of the alkane molecules are expressed in terms of three parameters. For the most reliable series of experimental data, the susceptibilities of 24 different hydrocarbons may be described by these parameters within an accuracy of 0.5%. Theoretical values of diamagnetic susceptibilities are given for 54 alkane molecules, namely for all isotopes up to and including octane, for the normal alkanes from nonane to hexadecane and for a few other molecules for which experimental data have been reported. The accuracy of the theoretical values is compatible with the accuracy of the measurements.

9949 THE VIBRATIONAL STRUCTURE OF ELECTRON EXCITATION LEVELS OF MOLECULES IN THE QUANTUM THEORY OF SCATTERING OF LIGHT.

L.L.Krushinskii and P.P.Shorȳgin.

Dokl. Akad. Nauk SSSR, Vol. 136, No. 3, 577-80 (Jan. 21, 1961). In Russian.

Contributions of vibrational sublevels to the matrix elements of the polarizability a^{mn} are estimated, including anharmonic effects. Theoretical expressions are derived for a^{02} and a^{01}. [English translation in: Soviet Physics—Doklady (USA)].

S.Chome

9950 E.S.R. OF IRRADIATED FROZEN H_2O_2—H_2O SOLUTIONS.

S.J.Wyard and R.C.Smith.

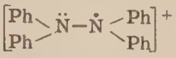
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 224-33 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). Radicals were produced in frozen solutions of H_2O_2 in H_2O by a variety of methods. These yielded a whole series of e.s.r. spectra. A qualive interpretation of this series of spectra is presented which ives it from a single radical, but no attempt is made to identify radical at this stage.

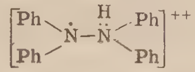
9951 ELECTRON SPIN RESONANCE STUDIES OF THE FREE RADICALS DERIVED FROM TETRAPHENYL-DRAZINE.

M.R.Das, A.V.Patankar and B.Venkataraman.
h. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 259-73 pt., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). The radicals derived from tetraphenylhydrazine, diphenylbenzidine diphenylamine under different conditions were investigated e.s.r. techniques. The identification and differentiation veen the radicals were done on the basis of their g-values and line-widths and hyperfine structure exhibited by their spectra. formation of the diphenylamine radical, Ph—Ṅ—Ph, by the rmal dissociation of tetraphenylhydrazine in nonpolar solvents confirmed. The same radical is obtained when tetraphenyl-razine is subjected to atmospheric oxidation in a non-polar vent. The tetraphenylhydrazine radical ion,



ormed (1) when a solution of tetraphenylhydrazine in acetic acid ubjected to prolonged atmospheric oxidation, (2) when a similar , hly prepared solution is heated and (3) when diphenylamine or enylhenzidine is subjected to oxidation in an acetic acid medium. believed that the protonated hydrazinium radical,



ults if an acetic acid solution of tetraphenylhydrazine is treated a few drops of concentrated sulphuric acid. The g-value of a 2 M solution of DPPH in xylene was measured as 347 ± 0.00004.

9952 APPLICATION OF ELECTRON SPIN RESONANCE TO THE STUDY OF FREE RADICALS PRODUCED BY ADIATION OF DEOXYRIBONUCLEIC ACID.

Van de Vorst, J.M. van der Kaa, J.Depireux, J.Duchesne A.J.Bertinchamps.
h Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 297-300 pt., 1960). In French.

9th Colloque Ampere Paper (see Abstr. 4734 of 1961).

9953 CHEMICAL SHIFTS IN THE N.M.R. SPECTRA OF ACETYLENES.

B.Braillon and R.Romanet.
h. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 537-42 (Sept.,)). In French.

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). surements were made, with respect to tetramethylsilane as an rnal standard, of the chemical shifts of the acetylenic hydrogen, ethylene, and terminal methyl in the linear monoacetylenes from tyne to 1-nonyne. The results obtained for the acetylenic rogen are different from those recently found for this hydrogen -halo-, hydroxyl-, alcoxyl- or amino-compounds.

9954 SPIN INVERSION OPERATOR IN NUCLEAR MAGNETIC RESONANCE.

R.L.Fulton and J.D.Baldeschwieler.
em. Phys. (USA), Vol. 34, No. 3, 1075-6 (March, 1961).

To avoid an inconsistency which appears in the discussion of le resonance experiments when making use of the spin rsion operator introduced by Coris (Abstr. 746 of 1959), an nded definition of the operator is suggested. E.F.W.Seymour

9955 STUDIES OF RATES OF CONVERSION AND POPULATIONS OF CONFORMATIONS IN SATURATED RING IPOUNDS. III. NN' DIMETHYL PIPERAZINE.

.Reeves and K.O.Strømme.
em. Phys. (USA), Vol. 34, No. 5, 1711-14 (May, 1961).

For previous work see Canad. J. Chem., Vol. 38, No. 8, 1241 ., 1960). At room temperature the two proton resonance signals rved in NN'-dimethyl piperazine are not of equal half-width. signal caused by the ring methylene protons broadens as the erature is lowered and below −40°C the spectrum is typical of $_2B_2$ case. These observations are indicative of fast interconion relative to the axial-equatorial chemical shift between two tical chair forms of this molecule at +40°C and slow in interersion below −40°C. The A_2B_2 spectrum is partially analysed, ing reasonable values for $J_{e_1a_1}$, $J_{e_1e_2}$, $J_{e_1a_2}$, and the axial-equatorial chemical shift assuming only that the value of $J_{a_1a_2}$ is known. The energy barrier for interconversion is computed from the coalescence temperature and the exchange broadened single peak near the fast exchange limit. It is found to be 13.3 ± 0.3 kcal. A comparison with earlier measurements in similar compounds is made. The N-methyl axial-equatorial motion is discussed.

9956 DISSOCIATION ENERGIES OF DIATOMIC MOLECULES.

E.R.Lippincott, R.Schroeder and D.Steele.
J. chem. Phys. (USA), Vol. 34, No. 4, 1448-9 (April, 1961).

Comment on Abstr. 20599 of 1960. It is pointed out that the relation k_er_e/D = constant can be derived from the potential function proposed in Abstr. 2661 of 1954, and that the relation cannot be used for excited states. A relation that can be used for excited states is given; it works well for O_2. J.Hawgood

9957 DISSOCIATION ENERGIES OF DIATOMIC MOLECULES.

G.R.Somayajulu.
J. chem. Phys. (USA), Vol. 34, No. 4, 1449-50 (April, 1961).

See preceding abstract. It is agreed that the proposed relation has limitations; however, it is expected to hold for similar bonds in sequences of polyatomic as well as of diatomic molecules. The relation $k_er_e^2/E$ = constant, where E is bond energy, is also discussed, and applied to S--S bonds. J.Hawgood

9958 EFFECT OF CONFIGURATION INTERACTIONS ON THE DISSOCIATION ENERGY AND HYPERFINE STRUCTURE CONSTANTS OF THE NO MOLECULE.

M.Yamazaki, M.Sakamoto, K.Hijikata and C.C.Lin.
J. chem. Phys. (USA), Vol. 34, No. 6, 1926-35 (June, 1961).

By means of a 23-dimensional configuration interaction calculation the energy and eigenfunction of the ground $^2\Pi$ state are determined resulting in dissociation energy of 2.2 eV. The magnetic hyperfine and nuclear quadrupole coupling constants are calculated from this molecular function. The contact term $|\Psi(0)|^2$ is obtained as 0.71×10^{-24} cm^{-3} which agrees well with experiment. The values of

$$\langle(3\cos^2\chi-1)\sigma/r^3\rangle_{Av},\ \langle\sin^2\chi/r^3\rangle_{Av},\ \text{and}\ \langle r^{-3}\rangle_{Av}$$

are not much affected by the configuration interactions.

9959 N.M.R. SECOND MOMENT OF A RADICAL OSCILLATING IN A PERIODIC POTENTIAL.

R.Chûjô.
J. Phys. Soc. Japan, Vol. 15, No. 1, 201 (Jan., 1960).

The author's expression for the second moment at low temperatures (Abstr. 881 of 1961), originally derived using classical statistical mechanics, is shown to be modified if the correct quantum statistics are used. E.F.W.Seymour

VELOCITY OF SOUND AND MOLECULAR STRUCTURE.

See Abstr. 9389

9960 POLYMERS OF CARBON DIOXIDE.

P.G.Bentley.
Nature (GB), Vol. 190, 432-3 (April 29, 1961).

Polymeric ions of the form $(CO_2)_n^+$ where n varies between 1 and 23 have been observed in the mass spectrum of CO_2. Possible sources of these ions are suggested. G.I.W.Llewelyn

9961 ON THE THEORY OF HELIX-COIL TRANSITION IN POLYPEPTIDES.

S.Lifson and A.Roig.
J. chem. Phys. (USA), Vol. 34, No. 6, 1963-74 (June, 1961).

The evaluation of the configurational partition function of a polypeptide molecule, with the internal rotation angles as variables, leads to an improved treatment of the phenomenon of helix-coil transition in polypeptide molecules. The conditional probabilities of occurrence of helical and coiled states of the peptide units are obtained in the form of a 3 × 3 matrix. The order of this matrix is the lowest possible for the model employed, and is derived by a logical procedure which serves to eliminate redundancies in the enumeration of states. The eigenvalues of this matrix yield the various molecular averages as functions of the degree of polymerization, temperature, and molecular constants. Explicit formulae are given for the degree of intramolecular hydrogen bonding, average number of helical sequences, and the distribution of their lengths, as well as the number average and the weight average of these lengths.

9962 THE PRODUCTION OF INTENSE MOLECULAR RAYS IN A HIGH VACUUM USING JETS. G.Becker.

Z. angew. Phys. (Germany), Vol. 13, No. 2, 59-64 (Feb., 1961). In German.

Experiments were carried out to obtain data for the development of an ammonia maser. The intensity and directional distribution of NH_3 molecular rays issuing from jet and slit systems of various dimensions was measured for rates ranging from 10^{15} to 3.6×10^{19} molecules/sec and referred to results for equivalent orifices. For systems with an effective length small compared to their geometrical length it was shown that the directional orientation of the beams was not improved by the use of tubular channels as compared with a slit system of the same smallest cross dimension. W.Steckelmacher

9963 THE MASS-SPECTRUM OF UNCHARGED FRAGMENT FROM ELECTRON IMPACT STUDIES ON MOLECUL

D.Beck and O.Osberghaus.

Z. Phys. (Germany), Vol. 160, No. 4, 406-19 (1960). In German.

Propane and hexane in the vapour state are broken down into ionized and neutral fragments upon impact with an electron beam (200 eV). The neutral fragments were ionized by further collisio with electrons and so identified mass-spectroscopically by means of appearance potentials and mass-numbers. A complete qualitati and quantitative analysis of the neutral decomposition products was carried out for propane. A "neutral" spectrum of the uncharg fragments was obtained by analysing the usual mass-spectrum. W.J.Orville-Thom

SOLID-STATE PHYSICS

9964 THE BINDING ENERGY OF THE σ BOND. II. APPLICATION TO THE DIAMOND CRYSTAL.

K.O-ohata.

J. Phys. Soc. Japan, Vol. 15, No. 7, 1258-63 (July, 1960).

A calculation of the cohesive energy of the diamond crystal was carried out by using the general scheme which is derived by the Heitler–London approximation in a preceding article (Abstr. 8851 of 1961). It was found that the value of the binding energy is about 3.26 eV per bond in rather good agreement with the observed one.

9965 MADELUNG CONSTANTS FOR SEVERAL STRUCTURES:

Q.C.Johnson and D.H.Templeton.

J. chem. Phys. (USA), Vol. 34, No. 6, 2004-7 (June, 1961).

Madelung constants are given for 38 structures, some of which are relatively complex. The Madelung constants for binary compounds are compared with an empirical rule previously formulated.

9966 CALCULATION OF THE MEAN INNER POTENTIAL OF A SILVER CRYSTAL AFTER IONIC ATTACK.

P.Haymann and C.Lecomte.

C.R. Acad. Sci. (France), Vol. 252, No. 12, 1746-7 (March 20, 1961). In French.

A properly directed ionic stream etches the surface of a silver crystal into dihedra, the edges of which lie in a preferred direction. Subsequent electron diffraction patterns show elongated spots from which the inner potential of the crystal may be calculated. A.E.I. Research Laboratory

9967 CRYSTAL FIELD PARAMETERS FOR ERBIUM IN Er $(C_2H_5SO_4)_3.9H_2O$. E.H.Erath.

J. chem. Phys. (USA), Vol. 34, No. 6, 1985-9 (June, 1961)

Intermediate coupling wave-functions and eigenvalues for f^{11} were used to compute the effective operator equivalent factors for the free-ion levels of erbium. The Stark splitting of the ground level ${}^4I_{15/2}$ was used in a first-order perturbation calculation on the ground state to determine the crystal field parameters. The parameters that fit the experimental data best are; $\langle r^2 \rangle A_2 = 125.80$, $\langle r^4 \rangle A_4 = -31.06$, $\langle r^6 \rangle A_6 = -81.19$, $\langle r^6 \rangle A_6^6 = 387.19$. The parameters were used to calculate the Stark splitting of the free-ion levels and the results compared with experimentally observed values for ten levels. For the 46 Stark levels involved the calculation predicts the splitting with an average deviation of 3.4 cm^{-1}.

THE NUCLEAR ZEEMAN EFFECT AND QUADRUPOLE SPLITTING OF Sn^{119} IN METALLIC TIN. See Abstr. 9806

9968 QUADRUPOLE INTERACTION IN CRYSTALS.

O.Nagai and T.Nakamura.

Progr. theor. Phys. (Japan), Vol. 24, No. 2, 432-54 (Aug., 1960).

The quadrupole array for the lowest energy of quadrupole interaction in crystals is obtained by generalizing Luttinger and Tisza's theory of dipole interaction (Abstr. 1043 of 1947). The theory is presented for the two kinds of problems: the simplest case of quadrupole pertaining to a doubly degenerate orbital e_g and the other general cases, both for cubic crystals. In the former case, the quadrupole interaction is written in terms of fictitious spins, whence one can obtain the solution of lowest energy classically, giving information on the orbital ordering in compounds with Mn^{3+}, Cu^{2+} and Cr^{2+}. In the latter cases, the five component of the quadrupole are totally effective, leading to a rather complicated problem. The classical solution is, however, easily obtained though somewhat complicated. The quadrupole array of lowest energy in face-centred cubic lattices proces to be realized in the molecular crystals N_2, N_2O, CO_2 and CO; it is accompanied by larg quadrupole but without or with small dipole moment.

LATTICE MECHANICS

9969 ON THE X-RAY TEMPERATURE DIFFUSE SCATTERING OF ANTHRACENE AND STEARIC ACID.

S.Annaka and J.L.Amorós.

J.Phys. Soc. Japan, Vol. 15, No. 2, 356-7 (Feb., 1960).

The X-ray diffuse scattering of anthracene crystals was qualitatively studied by the Laue method over most of reciprocal space and small areas on reciprocal planes were studied quantitatively by means of a counter spectrometer. Maps of some of the areas are given together with corresponding maps on the basis of theoretical considerations. The experimental observations can be explained qualitatively by assuming independent harmonic vibration of the molecules except near to the a* axis. To obtain quantitati agreement it is necessary to include the effect of librations. A similar qualitative agreement between experimental and calculated results can be obtained with stearic acid crystals by assuming independent harmonic vibration. J.Ibak

9970 SCATTERING OF NEUTRONS BY PHONONS IN A SINGLE CRYSTAL.

D.Cribier, B.Jacrot and D.Saint-James.

J. Phys. Radium (France), Vol. 21, No. 1, 67-9 (Jan., 1960). In French.

Results of measurements of the scattering of slow neutrons by a single crystal of copper are presented and discussed. A dispersion curve for longitudinal vibrations in the [110] direction is deduced and compared with the theory and measurements of Jacobsen (Abstr. 3258 of 1955) and with the theory of White (Abstr. 6227 of 1959). J.W.Leech

9971 DISPERSION OF LATTICE WAVES IN COPPER.

S.K.Joshi and M.P.Hemkar.

J. chem. Phys. (USA), Vol. 34, No. 4, 1458-9 (April, 1961).

The dispersion curve for the [110] direction in copper derived by Cribier et al. (see preceding abstract) is compared with a number of theoretical predictions. It is concluded that the best agreement is with the theory of Bhatia (Abstr. 3257 of 1955) but that further experimental work is required in order to produce a decisiv comparison. J.W.Leech

9972 ON THE INVERSION TEMPERATURE FUNCTION OF THE FIRST ORDER (ONE PHONON) SCATTERING AND THE DETERMINATION OF DEBYE CHARACTERISTIC TEMPERATURES. M.L.Canut and J.L.Amorós.

Proc. Phys. Soc. (GB), Vol. Pt 3, 712-20 (March, 1961).

Starting from Laval's expression (1941) for the first-order

nal diffuse scattering (TDS_1), a new expression for the inversion
erature of TDS_1, $T_{max} = m\Theta_D{}^2 d^2{}_{hkl} k/3h^2$, was obtained, valid
crystal of any symmetry. T_{max} is attained when
/d_{hkl} = 16%. Every crystalline substance has a definite range
e the above formula holds: the upper limit is T_{mp} and the
r limit is Θ_D. The melting temperature defines a d_{max} for
h the inversion phenomenon can be observable. The inversion
es of TDS_1 were calculated for some metallic, ionic and
cular crystals. It is shown that KCl, Pb and Al, for which the
sion phenomenon has been reported, are not special cases.
olecular crystals this effect will be observable mainly at low
eratures. A method is given for determining Debye character-
temperatures of crystals of any symmetry. This method is
d using Cartz's experimental T_{max} for lead.

973 VIBRATIONAL THERMODYNAMIC PROPERTIES OF LATTICES WITH DEFECTS. II. TWO- AND THREE-
ENSIONAL SIMPLE CUBIC LATTICES.
hanty, A.A.Maradudin and G.H.Weiss.
r. theor. Phys. (Japan), Vol. 24, No. 3, 648-60 (Sept., 1960).
For Pt I, see Abstr. 11590 of 1960. This work is a continuation
pplication to two- and three-dimensional crystals of the
ods of Pt I for evaluating the changes in thermodynamic
erties of a lattice due to the presence of defects of various
s. In particular the authors consider the effects of an isotope
t and a pair of isotope defects on the zero-point energy and
energy of two- and three-dimensional cubic lattices. The free
gy and self-entropy of a vacancy in a three-dimensional cubic
e are evaluated.

974 SOUND VELOCITY IN INDIUM AT LOW TEMPERATURES. R.David and T.Blangé.
ica (Netherlands), Vol. 26, No. 12, 1029 (Dec., 1960).
The velocity of 5 Mc/s longitudinal sound waves in poly-
talline indium is found to be (2.66 ± .02) × 10^5 cm sec^{-1} in
normal and superconducting states around 1.0°K. It is
fore concluded that the specific heat results of Bryant and
om (Abstr. 13489 of 1960) cannot be explained in terms of a
rence between the lattice Debye temperatures in the two
s. L.Mackinnon

975 ON THE THEORY OF THE ELECTRON—PHONON INTERACTION IN METALS. H.Stolz.
Phys. (Germany), Vol. 7, No. 7-8, 353-67 (1961). In German.
An improved calculation is given of the matrix element for the
sion or absorption of phonons. P.T.Landsberg

976 ON THE ELECTRON-PHONON INTERACTION. H.Puff.
Phys. (Germany), Vol. 7, No. 7-8, 368-70 (1961). In German.
A calculation was made of matrix elements for electronic
itions between stationary Bloch states due to a lattice defor-
on. P.T.Landsberg

ermal Properties

977 THE SPECIFIC HEAT HYPERFINE STRUCTURE OF SAMARIUM.
eyfus, B.B.Goodman, G.Trolliet and L.Weil.
Acad. Sci. (France), Vol. 252, No. 12, 1743-5 (March 20, 1961).
ench.
The specific heat of samarium was measured over the tempera-
range 0.4 to 2°K using a helium-3 crystal. Below 1°K the
fic heat shows a strong contribution, due to the hyperfine
etic coupling, of the form AT^{-2}. The experimental volume of
± 2 mJ $mole^{-1}$ deg, which corresponds to an effective field of
0.4) × 10^6 Oe acting on the nuclei, suggests that at low
eratures the ion Sm^{+++} is in the state $M_Z = \frac{5}{2}$. F.E.Hoare

978 HEAT CAPACITY OF ANTIFERROMAGNETIC $CuCl_2.2H_2O$ IN THE SPIN WAVE REGION.
etersen and N.E.Phillips.
em. Phys. (USA), Vol. 34, No. 4, 1463-4 (April, 1961).
Results of measurements of the specific heat of a compressed
rystalline sample over the range 0.2-0.55°K are presented and
ssed. They are found to be in disagreement with the theory of
e and Keffer (Abstr. 1045 of 1955). J.W.Leech

9979 SPECIFIC HEATS OF $HoCl_3.6H_2O$ AND $ErCl_3.6H_2O$ IN THE TEMPERATURE RANGE BETWEEN 1.2°K AND 230°K. W.Pfeffer.
Z. Phys. (Germany), Vol. 162, No. 4, 413-20 (1961). In German.

The specific heats were determined calorimetrically. The electronic components are given to a good approximation by c(Ho) – c_G(Gd) and c(Er) – c_G(Gd) (the differences between the measured specific heats and the lattice specific heat of $GdCl_3.H_2O$), and agree with values obtained from the crystal field splitting of the ground state at low temperatures. The behaviour of c(Ho) – c_G(Gd) above 10°K indicates that there are at least three further crystal field components of Ho^{+++} between 40 cm^{-1} and 250 cm^{-1}. Below 2°K, c(Er) – c_G(Gd) increases with decreasing temperature, which may be due to interactions between Er^{+++} ions and to hyperfine structure. J.Franks

9980 DEBYE Θ AND COMPRESSIBILITY OF CsCl TYPE CRYSTALS. S.S.Mitra and S.K.Joshi.
Physica (Netherlands), Vol. 26, No. 10, 825-6 (Oct., 1960).

Comparison of elastic and infrared data for TlCl, TlBr, CsCl and CsBr shows that the Debye Θ is better represented by the authors' formula (Abstr. 915 of 1961) than by that of Blackman (Handbuch der Physik, 1955). J.Hawgood

9981 THERMAL EXPANSION OF METALS. S.S.Mitra and S.K.Joshi.
J. chem. Phys. (USA), Vol. 34, No. 4, 1462-3 (April, 1961).

An expression is derived for the linear expansion coefficient of a Debye solid assuming a Morse-type interatomic potential function. Numerical values of α are calculated for a number of b.c.c. and f.c.c. metals using thermodynamic data, and these are compared with experimental values. J.W.Leech

9982 DENSITY AND EXPANSIVITY OF SOLID XENON. A.J.Eatwell and B.L.Smith.
Phil. Mag. (GB), Vol. 6, 461-3 (March, 1961).

The lattice parameter was determined by the Debye–Scherrer X-ray method and bulk density was also measured, between 20° and 120°K. The density and expansivity are tabulated at 20° intervals together with those of argon and krypton. Extrapolation to absolute zero gives a lattice parameter 6.13 A and density 3.78 g cm^{-3}. R.Berman

9983 THE EQUATION OF STATE OF IRON AT PRESSURES OF UP TO SEVERAL MILLIONS ATMOSPHERES.
V.N.Zharkov and V.A.Kalinin.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 4, 811-14 (Dec. 1, 1960). In Russian.

For abstract, see Abstr. 3610 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1253-6 (May-June, 1961)].

9984 A CONTRIBUTION TO THE THEORY OF MELTING. I.P.Bazarov.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 6, 1351-3 (Dec. 21, 1960). In Russian.

For abstract, see Abstr. 3611 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1293-5 (May-June, 1961)].

9985 THERMAL CONDUCTIVITY IN A BISMUTH ROD UNDER THE ACTION OF ULTRASONIC VIBRATIONS.
I.Bursuc.
An. Stiint. Univ. "Al.I.Cuza" Iasi (Ser. noua) I (Roumania), Vol. 6, Pt I, 137-41 (1960). In Roumanian.

A heat impulse is applied to one end of the rod and the difference in temperature, registered by two thermocouples placed along the bar, is plotted versus time by a photographic method. Time t_m corresponds to max. temperature difference and is used as a factor in the computation of thermal conductivity. U.S. vibrations at 2.5 Mc/s are coupled into the rod, using a piezoelectric quartz transducer, at a power density of about 0.4 W/cm^2 in the rod. When the vibrations are applied t_m increases by about 13% resulting in a 13% reduction in conductivity. The same reduction can be computed for the internal coefficient of thermal conduction if "c", the specific heat, is considered as constant. The measurements, formulae and plots are discussed. A.Reiss

9986 ANHARMONIC SOLIDS — THERMAL CONDUCTIVITY. F.Henin and L.Blum.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 10, 862-72 (1960).

Using a method developed by Prigogine and Henin, the thermal conductivity of an anharmonic crystal is obtained to the order λ^2. The calculation is performed using the "Brownian motion assumption" which enables results to be obtained by solving relatively simple equations. A correction due to dilatation effects is also included.

9987 THE EFFECT OF THE CONCENTRATION OF IMPURITIES AND ALLOYING ELEMENTS ON THE HEAT CONDUCTIVITY OF NICKEL AND ITS ALLOYS.
E. Yu.Nekhendzi.
Fizi. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 792-4 (May, 1960). In Russian.

Curves, illustrating the effect of various elements on the heat conductivity of Ni at room temp. and at 500° and 800°C, were constructed on the basis of experimental data published in the last 60 years. M.H.Sloboda

9988 DETERMINATION OF THE COEFFICIENT OF HEAT CONDUCTIVITY OF METALS IN THE HIGH TEMPERATURE RANGE. V.V.Lebedev.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 187-90 (Aug., 1960). In Russian.

The coefficient for Mo at 900°-2200°C was measured by a method based on the determination of the temperature gradient in a short central portion of a rod specimen, heated in vacuum by passage of electric current. The electrical conductivity of Mo at these temperatures was also measured, and the values of the Wiedeman—Franz ratio were calculated. M.H.Sloboda

9989 ON THE INFLUENCE OF THALLIUM ON THE THERMAL CONDUCTIVITY OF POLYCRYSTALLINE SELENIUM. G.B.Abdullaev, M.I.Aliev and S.A.Akhundova.
Fix. tverdogo Tela (USSR), Vol. 3, No. 2, 326-7 (Feb., 1961). In Russian.

Measurements were made from 20° to 90°C with thallium concentrations from 0.0125 to 1.5%. In all cases the conductivity decreases linearly with increasing temperature. Both the conductivity and its temperature coefficient are least for 0.05% Tl. It is suggested that the effect of Tl is first to act as impurity scatterer of phonons and then to increase the crystallite size. [English translation in: Soviet Physics—Solid State (USA)]. R.Berman

9990 ON THE CHANGE IN THE THERMAL CONDUCTIVITY OF TIN, BISMUTH AND GALLIUM ON MELTING.
B.P.Pashaev.
Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 416-19 (Feb., 1961). In Russian.

Three different types of behaviour are found: (1) Tin. A slight reduction before the melting point and a decrease by a factor 1.82 on melting, with a further slow fall to 310°C; (2) Bismuth. Increases just before melting point, doubles on melting and then continues to increase; (3) Gallium. Increases on approaching the melting point, a slight decrease on melting and then a continuous rise with changes of shape at ~140° and ~273°C. Discusses the relation between these results and the changes in density and coordination number. [English translation in: Soviet Physics—Solid State (USA)]. R.Berman

9991 THERMAL CONDUCTIVITY OF KNO_3.
I.Yoshida and S.Sawada.
J. Phys. Soc. Japan, Vol. 15, No. 1, 199-200 (Jan., 1960).

A 20% decrease was found at about 130°C, which corresponds to the phase change from the aragonite to the calcite structure. A large temperature gradient was used in the measurements and the decrease may in fact be nearly discontinuous. The explanation may lie in the 20% increase in expansion coefficient or in the rotation of the NO_3^- groups. Any anomaly connected with the ferroelectric phase, found in a narrow range between the other two on cooling (Abstr. 639 of 1960), may be obscured by the large temperature gradient. R.Berman

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ELECTRON STATES

CANCELLATION OF KINETIC AND POTENTIAL ENERGY IN SOLIDS. See Abstr. 9896

9992 SCATTERING OF ELECTRONS BY THE THERMAL MOTION OF IMPURITY IONS. S.Koshino.
Progr. theor. Phys. (Japan), Vol. 24, No. 3, 484-94 (Sept., 1960).

The scattering of electrons by the thermal motion of the exces electronic potential of impurity ions is discussed. The excess potential is assumed as a screened Coulomb interaction of electron with excess charges of impurity ions. The change in the electrical resistance of non-magnetic and substitutional dilute alloys due to this type of scattering is calculated at high temperature. It is assumed that the thermal motion of solute ions is quite similar to that of the perfect lattice. Calculated results are compared with the experimental deviations of the electrical resistance from Matthiessen's rule in cases of Cu-, Ag- and Au-based alloys. Agre ment between them is fairly good in most cases.

9993 QUASI-PARTICLE APPROACH TO INTERACTION IN AN IDEALIZED METAL. J.J.Quinn and R.A.Ferrell.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, No. 1-4, 18-24 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

The properties of a degenerate electron gas with a background of positive charge capable of propagating phonons are studied by means of a quasi-particle approach. The ground state of the system is pictured as a "vacuum" state, and any additional particles or holes together with their polarization clouds are thought of as quasi-particles. The Coulomb repulsion and the effective electron—electron attraction due to phonon exchange are treat separately. The specific heat, spin susceptibility and compressibi ity are determined in terms of the effective energy of interaction $V_{pp'}$ of two quasi-particles. Considering only the lowest order process contributing to $V_{pp'}$ reproduces known results for the high density limit Coulomb correction to the specific heat and spin susceptibility, but gives a new result for the phonon correction. T lowest order it is found that the electron—phonon interaction produces no change in the spin susceptibility, in contrast to genera expectation. For real metallic densities higher order graphs must be included; however for this case it may be possible to choose $V_{pp'}$ empirically.

9994 PHONONS AND PLASMONS.
R.Brout.
Plasma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 12, No. 1-4, 46-50 (Jan., 1961). [Proceedings of the 1959 International Plasma Physics Institute].

The interaction of a heavy mass positive plasma (mass M) with a light mass negative plasma (mass m) is examined in the random phase approximation. The problem is solved in this approximation by a normal mode analysis, leading to a dispersion relation which is analysed in detail. In the limit of low momentum transfer q, the results are identical to those of Bardeen (1937), Bohm and Staver (1952) and Bardeen and Pines (1955) corresponding to Coulomb interaction screened out with the Fermi—Thomas screening factor. Phonons arise with $c = \nu_f(m/3M)^{1/2}$; the plasma frequency is $(4\pi ne^2/\mu)^{1/2}$ where μ is the effective mass; ν_f = the Fermi velocity; n = the electron density; c = the sound velocity. The phonon decays into electron—hole pairs with a relaxation time given by conventiona perturbation theory using a screened electron—ion interaction. The screening arises in terms of a renormalized coupling constant, using a conventional field theoretic analysis. At high-momentum transfer ($q > 2p_f$), the phonon is stable (i.e. the imaginary part of the dispersion relation as a function of complex variable vanishes) and the analytic character of the spectrum changes. This effect, as pointed out by Kohn (1959) in another context, can lead to determination of the Fermi surface in metals. Its pertinence to the present theory was pointed out by Knight.

9995 CYCLOTRON RESONANCE IN INDIUM.
J.G.Castle, Jr, B.S.Chandrasekhar and J.A.Rayne.
Phys. Rev. Letters (USA), Vol. 6, No. 8, 409-10 (April 15, 1961).

Cyclotron resonance absorption in indium observable at 2.1°K and below reveals carriers having several values of effective mass. The results of preliminary measurements made at 9.1 kMc/s with d.c. magnetic field parallel to [111] direction are:-

Effective mass		Orbit
erimental	Theoretical	
22 ± 0.006	0.23	Type B arms in 3rd zone
55 ± 0.005	0.20	Type A arms in 3rd zone
9 ± 0.04		
8 ± 0.04		
4 ± 0.04	0.94	$K_H \sim 0$ orbits in 2nd zone.
± 0.1		

S.A.Ahern

9996 CYCLOTRON RESONANCE OBSERVATIONS IN CADMIUM. J.K.Galt, F.R.Merritt and P.H.Schmidt.
ys. Rev. Letters (USA), Vol. 6, No. 9, 458-60 (May 1, 1961).

With the steady magnetic field H parallel to the surface, bel--Kaner type oscillations were observed in several crystal entations, corresponding to masses of 0.5-1.3 m_0. With H mal to the surface, a sharp change in absorption occurred (at h 24 and 72 kMc/s) at a field corresponding to a mass of 1 m_0. R.G.Chambers

9997 THE ORIGIN OF THE CHARACTERISTIC ELECTRON ENERGY LOSSES IN ALUMINIUM AND MAGNESIUM.
.Powell.
sma Phys—Accelerators—Thermonuclear Res. (GB), Vol. 2, 1-4, 57-64 Jan.,(1961). [Proceedings of the 1959 International sma Physics Institute].

The characteristic electron energy loss spectra of aluminium magnesium have been measured by analysing the energy tribution of 750, 1000, 1500 and 2020 eV electrons scattered evaporated specimens through 90°. Measurements have also been de of the loss spectra of aluminium—magnesium alloys of unknown nposition using a primary electron energy of 1500 eV. It was nd that the loss spectra of both elements were similar in that y were composed entirely of combinations of two elementary rgy losses, 10·3 and 15·3 eV in aluminium and 7·1 and 10·6 eV magnesium. The alloy spectra were observed to consist of nbinations of a loss that varied between 10·6 and 15·3 eV in different specimens, and a low-lying loss that varied between 7·1 and 3 eV. From measurements of the relative positions and intenes of the two fundamental losses in each element, the observed nges in position and intensity of the low-lying loss in very thin ns of aluminium and the changes in position of the two fundamen- losses in the alloys, it was concluded that the larger fundamental s in each specimen was due to plasma excitation and that the aller loss was a lowered plasma loss of the type proposed by hie.

9998 CHARACTERISTIC ENERGY LOSSES OF FAST ELECTRONS DURING IRRADIATION OF AMORPHOUS D CRYSTALLINE As AND Ge FILMS. H.Richter and A.Rukwied.
Phys. (Germany), Vol. 160, No. 5, 473-80 (1960). In German.

Describes experiments on the effect of crystalline or amorus state on the characteristic energy losses in arsenic and manium. An electrostatic electron velocity analyser was ployed. The experimental loss values show a difference of 2 eV ween crystalline and amorphous arsenic. The results uphold Bohm-Pines plasma theory. A.E.I.Research Laboratory

9999 ELASTIC AND INELASTIC SCATTERING OF ELECTRONS IN SILVER FOILS. J.Geiger.
Phys. (Germany), Vol. 161, No. 3, 243-51 (1961). In German.

Describes experiments made on the energy loss and angular ttering distribution from single crystal silver films in a diffraction nera fitted with an electrostatic velocity analyser. The angular olution was 3×10^{-4} rad and the energy resolution was 0.8 eV at keV. The discrete energy losses found at 3.6, 7.5 are consistent the Bohm—Pines plasma oscillation theory.
A.E.I.Research Laboratory

10000 EXPERIMENTAL PROOF OF THE RADIATION FROM PLASMA OSCILLATIONS IN THIN SILVER LAYERS.
teinmann.
Phys. (Germany), Vol. 163, No. 1, 92-107 (1961). In German.

Electrons inelastically scattered in solid targets show a racteristic energy-loss spectrum, sharp lines appearing at tiples of 10 eV. This is partly explained by the plasma theory lectrons in metals, but certain discrepancies remain. An mpt is here made to elucidate these by studying instead the (optical) spectrum excited by electrons passing through thin silver foils. A sharp line found at 3300 A fulfils theoretical predictions.
A.E.I.Research Laboratory

DEFECT PROPERTIES

10001 A COMPARISON OF VACANCY AND INTERSTITIAL LOOPS IN GRAPHITE. G.K.Williamson and C.Baker.
Phil. Mag. (GB), Vol. 6, 313-14 (Feb., 1961).

The suggestion by Amelinckx and Delavignette (Abstr. 17946 of 1960) concerning the possibility of distinguishing between interstitial and vacancy loops in graphite was verified experimentally. Positive evidence for Amelinckx's interpretation of the Burgers vector of the vacancy loops was obtained.
R.F.Peart

10002 A POSSIBLE MECHANISM OF FORMATION OF SLIP-LINES IN THE ABSENCE OF LOCALIZED SOURCES OF DISLOCATIONS. E.D.Shchukin.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 1, 61-4 (Nov. 1, 1960).
In Russian.

For abstract, see Abstr. 7581 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1323-5 (May-June, 1961)].

10003 ON DISLOCATION LOOPS FORMED IN ZINC CRYSTALS DURING LOW TEMPERATURE PYRAMIDAL GLIDE. P.B.Price.
Phil. Mag. (GB), Vol. 6, 449-51 (March, 1961).

Electron microscopy of thin vapour-grown crystals which were strained at low temperatures in a micro-tensile device showed that the elongated dislocation loops were stable and showed no tendency to split up at −60° C. When the temperature was raised by about 10-20 deg. some splitting of the long loops into circular loops was brought about. The total area of the circular loops was the same as that of the parent loop to within 10%. Also the criterion for loop splitting was satisfied and the energy as calculated from the loop geometry was lowered by about 25% by the splitting. A.E.Kay

10004 DISLOCATION LOOPS AND HARDENING IN NEUTRON IRRADIATED COPPER.
M.J.Makin, A.D.Whapham and F.J.Minter.
Phil. Mag. (GB), Vol. 6, 465-8 (March, 1961).

From experiments in which copper foils were both irradiated and examined by electron microscopy at low temperatures (-195° to -50°C) it is inferred that dislocation loops must be formed from interstitial atoms and not from vacancies. Electron metallography and mechanical property measurements were also carried out on specimens during annealing at 306°C. The micrographs revealed a high density of small defects (<25 A) and it is argued that the temperature dependence of the lattice hardening is probably associated with submicroscopic defects which transform to these observable small defects on annealing. A.E.Kay

10005 THE COOPERATIVE MOVEMENT OF DISLOCATIONS IN VERY PURE ALUMINIUM FOIL.
R.N.Wilson and P.J.E.Forsyth.
Phil. Mag. (GB), Vol. 6, 453-4 (March, 1961)

The movement of dislocations in foils of both super purity and zone refined aluminium was studied using transmission electron microscopy with a micro-tensile device. In super purity aluminium the dislocations moved independently whereas in the zone refined metal they moved in a cooperative manner. It is suggested that the cooperative movement is due to the absence of elements such as point defects and impurity atoms which reduces the lattice friction and so increases the effectiveness of the attractive forces between like dislocations on neighbouring slip planes. A.E.Kay

10006 ROTATIONAL SLIP AND PSEUDO-STRUCTURE OF MUSCOVITE MICA. R.Cartraud and R.Zouckermann.
J. Phys. Radium (France), Vol. 21, No. 1, 73-4 (Jan., 1960).
In French.

An apparent superlattice effect in electron diffraction photographs is explained as being due to successive reflection from misoriented layers [see Zouckermann and Corcuff, C.R. Acad. Sci. (France), Vol. 245, 2323 (1957)]. A.R.Stokes

10007 STRUCTURAL CHANGES IN ALUMINIUM DURING LIGHT DEFORMATION AND SUBSEQUENT HEATING.

S.S.Gorelik, S.M.Kal'yanova and V.M.Rozenberg.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 251-61 (Aug., 1960). In Russian.

Slip patterns and grain boundary displacement in cold-worked Al (< 12% deformation in compression) were studied, as well as the grain-growth in subsequently annealed specimens. It is concluded that the mechanism of plastic deformation is the same both below and above the critical degree of work-hardening, slip within the grains playing the predominant part in both cases. The basic structural changes taking place during annealing of Al, cold-worked below the critical degree of deformation, consist of polygonization and slight displacement of the grain boundaries, the latter process being a result of the tendency of the system to reduce its free surface energy. Annealing of critically deformed Al brings about rapid grain-growth and frontal displacement of the grain boundaries. The latter process is caused by the difference in the elastic energy of the adjacent grains, the rate and the extent of the grain boundary displacement greatly exceeding those associated with the free surface energy. Nucleation and growth of new grains during annealing take place only in Al cold-worked above the critical degree of deformation. M.H.Sloboda

10008 BECKE LINES IN CdS CRYSTALS.

H.Radelt.
Z. phys. Chem. (Germany), Vol. 215, No. 3-4, 263-6 (1960). In German.

Discusses possible connections of these lines with other defect phenomenon. J.E.Caffyn

THE INFLUENCE OF SEVERAL FACTORS ON THE GROWTH OF SUB-GRAINS IN POLYCRYSTALLINE ALUMINIUM DURING THERMAL CYCLING. See Abstr. 9109

Diffusion

10009 DIFFUSION OF COBALT AND SILVER IN ORDERED AND DISORDERED CuZn.

C.Bassani, P.Camagni and S.Pace.
Nuovo Cimento (Italy), Vol. 19, No. 2, 393-5 (Jan. 16, 1961).

An advance report of the results of diffusion experiments carried out in the temperature range 700°C to 320°C. Above the order–disorder transition temperature log D versus 1/T gave straight lines: at the transition temperature and below more complex relationships were found and are discussed briefly. D.G.Holloway

10010 HELIUM DIFFUSION THROUGH GLASS.

V.O.Altemose.
J. appl. Phys. (USA), Vol. 32, No. 7, 1309-16 (July, 1961).

Helium permeation rates were determined through 20 different glasses using a mass spectrometer to measure the gas flow rates directly. The temperature range investigated was 25°-500°C. Values of diffusion constants and solubilities were computed for 10 of these glasses. The permeation rate was related to glass composition. It is felt that a better correlation exists between log permeation rate and mole % of glass network former (SiO_2, B_2O_3, and P_2O_5) content than exists between log permeation and wt % of network former as used by previous workers.

10011 THE COEFFICIENT OF DIFFUSION OF HELIUM IN TITANIUM. A.M.Rodin and V.V.Surenyants.

Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 216-22 (Aug., 1960). In Russian.

Diffusion of He in Ti was studied by measuring the rate at which dissolved He was given off by Ti heated in vacuum at 615°, 650°, 686°, and 720°C. High initial concentrations of He^3 in Ti was attained by a suitable treatment of thin (0.4 μ) films of Ti, vacuum-deposited on Mo substrates and saturated with H^3. No diffusion of He^3 in Mo was observed under the experimental conditions employed. The time-dependence of the rate of diffusion of He^3 in Ti differed from the theoretical relationship in that the rate of evolution of He^3 increased slightly as the He^3 content in Ti decreased. The diffusion coefficient, D, varied with temperature according to the formula

$$D = 1.1 \times 10^{-9} \exp -16100/RT.$$

M.H.Sloboda

10012 THE EFFECT OF MECHANICAL STRESSES AND DEFORMATION ON SELF-DIFFUSION. A.V.Savitskii.

Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 4, 564-71 (Oct., 1960). In Russian.

Self-diffusion in silver and iron was not affected by tensile stresses of 0.4-1.2 kg/mm² applied between 460° and 790°C. Similarly tensile stresses of 0.9-1.4 kg/mm² applied between 720° and 800°C did not affect self-diffusion of iron in low-carbon steel. A.Tybulewic

Colour Centres

10013 THE BLUE COLOUR OF APATITES.

V.M.Vinokurov and M.M.Zaripov.
Dokl. Akad. Nauk SSSR, Vol. 136, No. 1, 61-2 (Jan. 1, 1961). In Russian.

For abstract, see Abstr. 4994 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 6, No. 1, 29-30 (July, 1961)].

10014 ALPHA COLOR CENTER IN FLUORITE CRYSTALS.

B.R.Gossick.
Physica (Netherlands), Vol. 26, No. 6, 378 (June, 1960).

Some evidence is given for the two proposed models of the centre: (a) two electrons trapped at a fluorine vacancy and (b) plasma resonance of conduction electrons in colloidal Ca impurity. J.E.Caffyn

10015 SCATTERING OF NON-LOCALIZED EXCITONS ON F-CENTRES. Z.S.Kachlishvili.

Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 492-9 (Feb., 1961). In Russian.

The effective cross-sections are calculated for elastic and inelastic scattering of non-localized excitons on F-centres; inelastic scattering produces 1s–2p excitation in F-centres. The general expressions for cross-sections are applied to the special case of NaCl. [English translation in: Soviet Physics - Solid State (USA)]. S.Chomet

10016 ONE MECHANISM OF ELECTRON EXCITATION FOR A MODEL OF F-CENTRE AND EXCITON MOLECULAR ORBITS. A.A.Tsertsvadze.

Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 505-13 (Feb., 1961). In Russian.

Calculations are made by the LCAO method of the excitation energy of an electron moving in the field of a vacancy in the lattice, and in the field due to an uncharged atom. Calculations are made assuming point electrons. Results are tabulated for various alkali-halide crystals and comparisons with experiment are made. [English translation in: Soviet Physics - Solid State (USA)]. K.G.Major

10017 EXPERIMENTAL STUDY OF THE SHAPE OF THE F BAND ABSORPTION IN NaCl.

J.J.Markham and J.D.Konitzer.
J. chem. Phys. (USA), Vol. 34, No. 6, 1936-42 (June, 1961).

The possibility of extending the authors' study (Abstr. 6180 of 1960) of the optical absorption band associated with F centres in KCl to KI, KBr, and NaCl is explored. Due to the relative sizes and positions of the K and F bands in KI and KBr, one cannot resolve the two. The situation in NaCl is unclear; hence, a detailed study was made. A unique F centre can be formed in this crystal by various techniques. The optical bleaching properties depend on the means of production. Smakula's equation applies to this centre, and it seems to be Prekarian. The "best equation" for the width at half-height H (in eV), has the form $H^2 = 0.075 \coth (105.5/\theta) - 0.01$; where θ is the temperature. This study supports the general theory (Abstr. 2806 of 1960) although all the experimental problems have not been resolved.

10018 ON THE THEORY OF PHOTOIONIZATION OF F-CENTRES. Yu.E.Perlin and M.E.Palistrant.

Optika i Spektrosk. (USSR), Vol. 9, No. 5, 608-14 (Nov., 1960). In Russian.

Continuous states of the F-centre spectrum are interpreted as polarons moving in the screened Coulomb field of an anion vacancy. The probability of a phototransition into such continuous ionized states from the ground state is calculated. It is shown that, due to participation of phonons, the dependence of the ionization probability on the frequency of absorbed light is an asymmetrical curve with a maximum. In the long-wavelength region this curve is similar to

ar's curve for phototransitions in the discrete spectrum; in the
rt-wavelength region the curve falls more smoothly than Pekar's
ve. With increase of temperature the magnitude of the photo-
zation probability maximum decreases and the half-width of the
bability curve increases. [English translation in: Optics and
ctrosc. (USA), Vol. 9, No. 5, 320-3 (Nov., 1960)].

A.Tybulewicz

OPTICAL BLEACHING OF R-BANDS IN LiF CRYSTALS.
Abstr. 10102

0019 EXCITON-INDUCED PHOTOCONDUCTIVITY OF U CENTRES IN KCl CRYSTALS. M.Ueta and M.Hirai.
hys. Soc. Japan, Vol. 15, No. 7, 1356-7 (July, 1960).

The spectral distribution of photocurrent due to U—F con-
sion by light of intensity of 10^{11} to 5×10^{11} photons cm^{-2} sec^{-1} is
orted. The photocurrent was also shown to decrease by prior
version of the U-centres to F-centres by exposure to ultraviolet
t.

J.E.Caffyn

diation Effects

10020 THE EFFECT OF NEUTRON IRRADIATION AT LOW TEMPERATURES ON THE ELECTRICAL CONDUC-
TTY OF LiF. M.Dubois, P.Berge and G.Blanc.
. Acad. Sci. (France), Vol. 252, No. 14, 2096-8 (April 5, 1961).
rench.

The comparison of the effects of irradiation in a nuclear
ctor on LiF, at the ambient temperature and at the temperature
iquid nitrogen, is used to determine the rearrangement
hanism of the primary defects formed. It is deduced that the
ondary defects formed are a complex of a Li vacancy assoc-
d with a F vacancy, which being electrically neutral does not
tribute to the conductivity.

A.J.Fox

0021 THE EFFECT OF FAST NEUTRONS ON THE PROPER-TIES OF METALS. Sh.Sh.Ibragimov and V.S.Lyashenko.
Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 183-6
., 1960). In Russian.

Hardness, (H), electrical resistivity, (ρ), and Ultimate Tensile
ngth (UTS) of preliminarily annealed f.c.c. (Al, Cu, Ni) and
c. (Fe, Mo, W) metals increased after irradiation with fast
trons, the increase attained being determined by the crystal struc-
and m.p. of the metal. Since the variation of (ρ) with increasing
grated radiation dose was different from that of H and UTS,
since a higher annealing temperature was required to restore
n irradiated metal its initial conductivity, it was postulated that
radiation-induced increase in H and UTS was not due to the
nation of Fraenkel defects.

M.H.Sloboda

0022 DEFORMATION UNDER IRRADIATION OF URANIUM AT LOW TEMPERATURE. Y.Quéré and J.Doulat.
. Acad. Sci. (France), Vol. 252, No. 9, 1305-7 (Feb. 27, 1961).
rench.

Experiments previously carried out at the temperature of
id nitrogen were repeated at that of liquid hydrogen. The same
lency was observed for the uranium growth to increase consider-
as the temperature decreases, a result which is in conflict
that previously reported by Turkalo (cited by Holden: Physical
allurgy of Uranium, p. 178), but which is corroborated by
ent work at Harwell.

J.Thewlis

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

10023 THE THEORY OF THE ELECTRICAL RESISTANCE ANOMALIES OF THE RARE EARTH METALS.
J.Seiden.
C.R. Acad. Sci. (France), Vol. 252, No. 13, 1922-4 (March 27, 1961).
In French.

Calculates the temperature variation of the resistivity by assuming the Nordheim model in the evaluation of the cross-section of scattering of the conduction electrons by the magnetic ions.

E.P.Wohlfarth

10024 ELECTRICAL RESISTIVITY OF CHROMIUM IN THE VICINITY OF THE NÉEL TEMPERATURE.
M.J.Marcinkowski and H.A.Lipsitt.
J. appl. Phys. (USA), Vol. 32, No. 7, 1238-40 (July, 1961).

Previous work by other investigators has shown that a sharply cusped minimum occurs in the resistivity—temperature relationship for fully recrystallized chromium at the Néel temperature, i.e., 35°C. Plastic deformation, on the other hand, eliminates this minimum, and in addition gives rise to a pronounced change in the resistivity—temperature relationship over a wide range of temperatures centred about the Néel temperature. These results were corroborated in the present paper. Furthermore, this behaviour was analysed and interpreted in terms of the strong dependence of the Néel temperature on hydrostatic stresses which are thought to arise from the presence of dislocations in the deformed material.

10025 THE ELECTRICAL RESISTIVITIES AND MAGNETIC SUSCEPTIBILITIES OF SOME STABLE AND META-STABLE URANIUM—MOLYBDENUM ALLOYS.
L.F.Bates and R.D.Barnard.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 691-9 (March, 1961).

The magnetic susceptibilities and electrical resistivities of a series of quenched γ body-centred cubic uranium—molybdenum alloys were measured over the temperature ranges 293°—1200°K and 90°—1200°K, respectively. U-15 20, 25 at.% Mo each possessed a small negative temperature coefficient of resistivity below about 200°C in the metastable γ-state, and a positive coefficient in the stable γ-region. All samples exhibited a Pauli weak spin paramagnetism which increased with temperature, and in addition possessed an exchange contribution shown to be independent of composition over the range 15—30 at.% Mo. The bearing of the results on out understanding of the electronic structure of the γ-alloys is discussed.

ELECTRICAL RESISTIVITY AND STRUCTURE OF THE COBALT—TUNGSTEN CARBIDE ALLOYS. See Abstr. 9144

ELECTRICAL CONDUCTIVITY OF DILUTE ALLOYS: EFFECT OF ELECTRON SCATTERING BY THE THERMAL MOTION OF IMPURITY IONS. See Abstr. 9992

10026 ELECTRICAL AND OPTICAL PROPERTIES OF GaAs—InAs ALLOYS.
J.C.Woolley, C.M.Gillett and J.A.Evans.
Proc. Phys. Soc. (GB), Vol. 77, Pt 3, 700-4 (March, 1961).

Solid specimens showing a composition spread of less than 3 mol.%, were prepared by a slow directional freeze technique. These specimens were used for measurements of Hall effect and conductivity as a function of temperature and for infrared transmission measurements to determine the optical gap E_G. The electrical measurements show that there is mixed conduction in the alloys and hence the values of Hall mobility have no significance. The optical measurements to determine the variation of E_G with composition are in good agreement with values obtained by diffuse reflection methods on single phase powder samples. The values of E_G show a linear variation over most of the composition range.

10027 ELECTRICAL AND MAGNETIC PROPERTIES OF NICKEL FILMS VACUUM-DEPOSITED ON GLASS.
A.S.Mil'ner and L.I.Tatarinova.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 673-9 (May, 1960). In Russian.

The Ni films, had electrical resistance, R, higher, and the

intensity of magnetization, a, considerably lower than similar films which, after deposition, had been annealed at 400°C. In addition, the untreated films were characterized by anomalous temperature-dependence of R and a, the former decreasing rapidly with rising temperature, and the latter becoming zero at temperatures $<$ the Curie point of massive Ni. The effects observed are attributed to the fact that Ni films, deposited on cold glass substrates, consist of isolated grains below the "critical" size. On heating to 400°C, the grains coalesce and the films recover their normal properties.
M.H.Sloboda

10028 ON CALCULATIONS OF ELECTRICAL CONDUCTIVITY OF TWO-COMPONENT SINTERED MATERIALS.

A.I.Raichenko and I.M.Fedorchenko.

Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 815-22 (June, 1960). In Russian.

Based on a solution of the equation of diffusion for a model of a two-component, sintered powder body, a formula was derived for electrical conductivity, λ, of a sintered alloy of two mutually soluble metals. Its validity was confirmed both by experiments, carried out on Cu—Ni alloys containing 80, 60, and 40% Cu, and by theoretical evaluation of λ of these alloys, based on calculated and experimentally determined concentration distribution.
M.H.Sloboda

10029 HALL EFFECT IN THE INTERMETALLIC COMPOUND $MnAu_2$. I.G.Fakidov and V.N.Novogrudskii.

Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 1, 158-60 (July, 1960). In Russian.

The effect of the intensity of an external magnetic field, H, and the intensity of magnetization, σ, on Hall e.m.f., E, in $MnAu_2$ was studied. At room temperature, the E(H) relationship was linear in the antiferromagnetic range (i.e. at $H \leq 8 \times 10^3$ Oe). At 96°C (i.e. above the Néel point), higher E was generated, and E(H) was linear throughout the investigated range of $H \leq 24 \times 10^3$ Oe. The E(σ) graph consisted of two linear branches. It was concluded that the transition of $MnAu_2$ to the ferromagnetic state is accompanied by a change in the mechanism of generation of E. M.H.Sloboda

10030 CORBINO DISK MAGNETORESISTIVITY MEASUREMENTS ON InSb. M.Green.

J. appl. Phys. (USA), Vol. 32, No. 7, 1286-9 (July, 1961).

Magnetoresistivity measurements employing "Corbino disk" geometry were made, at temperatures of 77°, and 203°K, and at approximately room temperature, on a slice of fairly high-purity, single-crystal, n-type InSb (probably compensated) with excess impurity concentration $N_D - N_A$ of about 7×10^{15}. In a series of measurements the ratios of the resistance at 20 kG to that at zero field, for the temperatures and in the order listed above, were found to be approximately 23, 23, and 33. The maximum magnetic coefficients of resistance, in the same order, were approximately 0.87, 0.70, and 0.50 per kG occurring approximately at field of 0.7, 1.0, and 2.6 kG, respectively. Mobilities were determined by both Hall effect and low-field magnetoresistivity, and were found to agree within a few per cent. The values were, in the same temperature order, 7.3, 5.3, and 4.5 $m^2\ V^{-1}\ sec^{-1}$. Temperature cycling and ageing appear to cause a reduction in area of soldered contacts to the specimen. Very slight variations of magnetoresistance with the polarity of current through the specimen were observed. An explanation is given; calculations are of the same order of magnitude as experimental observations.

10031 MEASUREMENTS OF THE HALL EFFECT IN THE BINARY MIXED CRYSTAL RANGE OF IRON.

W.Jellinghaus and M.P.de Andrès.

Z. angew. Phys. (Germany), Vol. 13, No. 3, 121-2 (March, 1961). In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). By substitution of metallic impurities of Fe changes in the sign of the Hall constant may be observed. Substitution of Ti and Cu raise the Hall constant, the effect being greater for greater atomic number of the substituted element. C.A.Hogarth

10032 MAGNETOTHERMAL EFFECTS IN SEMIMETALS IN STRONG MAGNETIC FIELDS.

A.I.Ansel'm and B.M.Askerov.

Fiz. tverdogo Tela (USSR), Vol. 2, No. 9, 2310-2321 (Sept., 1960). In Russian.

Discusses the effect of quantization of conduction electrons in a magnetic field on magnetothermal effects. In a quantum expression for an electric field, a local temperature, which occurs in the electron distribution function, is regarded as dependent on centres of vibrations of magnetic oscillators. Dependence of the Nernst coefficient and of thermoelectric power on temperature and magnetic field intensity is calculated in the quantum limit. [English translation in: Soviet Physics—Solid State (USA), Vol. 2, No. 9, 2060-70 (March, 1961)]. A.Tybulewicz

10033 INVESTIGATION OF THE ELECTRICAL CONDUCTIVITY OF RUBIDIUM—BORON GLASSES. B.I.Markin.

Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 450-5 (Feb., 1961). In Russian.

Data are given for the composition, density, specific and equivalent conductivities of 10 glasses formed from boric acid and containing from 11 to 57% Rb_2O by weight. The logarithm of specific conductivity varies linearly with the reciprocal of absolute temperature; the specific conductivity increases by a factor of several millions over the range of concentrations investigated. The graphs of equivalent conductivity against Rb concentration show minima at low concentrations. The significance of the minima is discussed and the behaviour of the system is compared with that of systems containing other alkalis. [English translation in: Soviet Physics—Solid State (USA)]. R.F.S.Hearmon

10034 ELECTRICAL CONDUCTIVITY OF NaCl DURING HIGH-TEMPERATURE CREEP.

R.W.Christy and W.E.Daniels, Jr.

J. appl. Phys. (USA), Vol. 32, No. 7, 1265-8 (July, 1961).

Measurements were made on the conductivity in the intrinsic range during and after deformation by creep. The conductivity is proportional to the diffusion coefficient for Na. At about 550°C, no change in conductivity was observed, even at steady-state creep rates approaching 10%/min. This negative result is shown to be in accord with theoretical estimates.

10035 NONOHMIC BEHAVIOR IN NEAR-STOICHIOMETRIC RUTILE (TiO_2). E.H.Greener and D.H.Whitmore.

J. appl. Phys. (USA), Vol. 32, No. 7, 1320-4 (July, 1961).

Experimental observations of the isothermal current—voltage relationships in rutile (TiO_2) over the temperature range 632°-908°C showed that currents in excess of ohmic currents can be drawn through small, single crystals of near-stoichiometric composition. These currents were identified as space-charge-limited currents analogous to those observed in the case of a vacuum diode. An increase in the ambient specimen temperature had the effect of displacing the potential for transition from ohmic to nonohmic behaviour to greater values so that, at 908°C, near-stoichiometric rutile exhibited only ohmic currents even at the largest fields employed.

10036 ELECTRICAL CONDUCTIVITY OF α-Fe_2O_3.

T.Nakau.

J. Phys. Soc. Japan, Vol. 15, No. 4, 727 (April, 1960).

The electrical conductivity of natural single crystals of α-Fe_2O_3 containing Ca, Mg and Sn impurities was measured as a function of temperature. The results show anisotropy of the conductivity and of the slope of the log (conductivity) versus reciprocal temperature curve along different crystallographic axes. There is also an anomaly in each curve at the magnetic transition temperature of -20°C. J.B.Birks

10037 ELECTRONIC PROPERTIES OF PHENAZINE.

S.Aftergut and G.P.Brown.

Nature (GB), Vol. 189, 827-8 (March 11, 1961).

The variation of resistance with temperature was measured in the range 98°-143°C for samples of phenazine. These measurements indicate an energy gap of 2.1 eV which was compared with the excitation energy of the ground-triplet state transition in the molecule, of 1.9 eV. This relationship is supported by similar results which have been published for other organic substances e.g. anthracene chrysene. K.N.R.Taylor

Semiconductors

10038 ROLE OF TRAPPING PROCESSES IN THE INTERPRETATION OF LIFETIME OF CARRIERS.

N.Hayano.

Bull. Kyushu Inst. Technol. Math. nat. Sci. (Japan), No. 6, Pt 1, 29-34 (March, 1960).

Differential equations are set up for the change of concentrations in a number of different trapping situations. P.T.Landsberg

0039 INTERVALLEY SCATTERING OF HOT ELECTRONS.
M.Shibuya and W.Sasaki.
hys. Soc. Japan, Vol. 15, No. 1, 207-8 (Jan., 1960).

The electron temperature approximation discussed by Shockley
51) is modified to include intervalley lattice scattering, important
many-valley semiconductor. The resultant equations are found
epresent the experimental data of n-type Ge at room tempera-
.
C.A.Hogarth

miconducting Materials

10040 MINERALS AS MODELS FOR NEW SEMICONDUCTING COMPOUNDS. G.Busch and F.Hulliger.
v. phys. Acta (Switzerland), Vol. 33, No. 6-7, 657-66 (1960).
German.

New semiconductor compounds may be made by combining
ary compounds to form ternary or quaternary systems. Some
h compounds compare with sulphide compounds which occur in
ure. A number of new compounds are described (e.g. $AgGeSbSe_3$
$TlPb_2BiSe_4$) and their lattice constants and energy gaps are
ed.
C.A.Hogarth

0041 ELECTRICAL CONDUCTIVITY OF n-Ge IN STRONG MAGNETIC FIELDS. E.A.Zavadskii and I.G.Fakidov.
. Metallov i Metallovedenie (USSR), Vol. 10, No. 3, 495-6
pt., 1960). In Russian.

The magnetoresistance of 30 Ω-cm n-Ge was measured in
sed fields up to 220 kOe and at 77°-316°K. At the higher
peratures $\Delta\rho/\rho$ tended to a constant value with increasing field
at lower temperatures a linear variation of $\Delta\rho/\rho$ with field was
ibuted to the quantization of cyclotron orbits. D.J.Huntley

10042 RESISTIVITY OF HEAVILY DOPED GERMANIUM.
V.I.Fistul' and A.Ya.Gubenko.
. tverdogo Tela (USSR), Vol. 3, No. 5, 1617-19 (May, 1961).
Russian.

Based on experimental data obtained on As-doped Ge, empirical
mulae $\rho_n = 4.3 \times 10^8 n^{-0.6}$ and $\rho_p = 8.15 \times 10^9 n^{-0.66}$ were derived,
re ρ_n and ρ_p are resistivities of n- and p-type Ge, respectively,
n is the impurity concentration. The formulae are valid for
4×10^{16} cm^{-3}. [English translation in: Soviet Physics—Solid
e (USA)].
M.H.Sloboda

0043 ANODIC OXIDATION OF GERMANIUM.
T.Gabor.
ppl. Phys. (USA), Vol. 32, No. 7, 1361-3 (July, 1961).

On anodic polarization of etched samples of n-type or near-
insic p-type germanium, striations are formed. The periodic
letion of holes is advanced as a tentative explanation of the pheno-
ion.

0044 TUNNELING PROBABILITY IN GERMANIUM P–N JUNCTIONS. Y.Furukawa.
hys. Soc. Japan, Vol. 15, No. 4, 730 (April, 1960).

Measurements on Esaki diodes prepared by alloying In spheres
Ge indicate that for the same electron densities the mobilities
e doped with Sb are greater than in Ge doped with As: an effect
cannot be attributed to compensation. The maximum tunnelling
rent is found to be dependent on the specific donor impurity and
ttributed to a change in the density of states or effective mass.
C.G.Williams

0045 GENERATION–RECOMBINATION NOISE IN P-TYPE GOLD-DOPED GERMANIUM.
Neuringer and W.Bernard.
s. Rev. Letters (USA), Vol. 6, No. 9, 455-7 (May 1, 1961).

Preliminary estimates of the capture cross-sections of free
s by the 0.041 eV donor level and the 0.145 eV acceptor level
obtained from measurements of the generation–recombination
e spectrum in the range 10^4-10^7 c/s. The experiment was
ormed at 97°K and at this temperature the noise spectrum
ltaneously exhibits relaxation times characteristic of both
ls. The results are in good agreement with the theory based
two-impurity-level model, using total cross-sections
$_A = 1.55 \times 10^{-12}$ cm^2 and $\sigma_D = 3.75 \times 10^{-18}$ cm^2. A.J.Fox

10046 LOW-FREQUENCY CONDUCTIVITY DUE TO HOPPING PROCESSES IN SILICON. M.Pollak and T.H.Geballe.
Phys. Rev. (USA), Vol. 122, No. 6, 1742-53 (June 15, 1961).

The complex conductivity was measured in n-type silicon with various kinds of impurities at frequencies between 10^2 and 10^5 c/s and temperatures between 1° and 20°K. In most cases it is orders of magnitude larger than the measured d.c. conductivity and is attributed to polarization caused by hopping processes. The observed frequency dependence in the measured range can be expressed as $A\omega^{0.8}$, where A is a complex constant. At the low-temperature end the conductivity is roughly proportional to minority impurity concentration and is almost independent of the majority impurity concentration. At higher temperatures the conductivity becomes approximately proportional to the product of both concentrations. A simple theory, based on the currently accepted model of impurity conduction, is given for the higher temperature range. It accounts well for the observed frequency and concentration dependences. However, only order-of-magnitude absolute agreement is obtained.

N- AND P- TYPE SINGLE CRYSTAL BISMUTH TELLURIDE.
See Abstr. 9116

10047 PREPARATION AND PROPERTIES OF GLASSY OXIDE SEMICONDUCTORS OF THE $VO_{2.5}$–$PO_{2.5}$–RO_x TYPE. L.A.Grechanik, N.V.Petrovȳkh and V.G.Karpechenko.
Fiz. tverdogo Tela (USSR), Vol. 2, No. 9, 2131-9 (Sept., 1960).
In Russian.

Reports a study of semiconducting $VO_{2.5}$–$PO_{2.5}$–RO_x glasses (R represents an element of group I, II or V). Deals with their preparation (vitrification), melting points and rate of solidification, viscosity, tendency to crystallize out, infrared transmission spectra, electrical conductivity and thermoelectric power. [English translation in: Soviet Physics — Solid State (USA), Vol. 2, No. 9, 1908-15 (March, 1961)]. A.Tybulewicz

10048 OBSERVATION OF MICROPLASMA PULSES AND ELECTROLUMINESCENCE IN GALLIUM PHOSPHIDE SINGLE CRYSTAL. M.Kikuchi and T.Iizuka.
J. Phys. Soc. Japan, Vol. 15, No. 5, 935 (May, 1960).

With a W contact to a GaP single crystal, microplasma pulses were obtained over a range of reverse bias voltages. Electroluminescence emission occurred below the point contact.
J.Franks

10049 SEMICONDUCTING "COMPOUND" $AgFeTe_2$.
J.H.Wernick and R.Wolfe.
J. appl. Phys. (USA), Vol. 32, No. 4, 749 (April, 1961).

X-ray powder photographs and photomicrographs show that $AgFeTe_2$, as made, contains at least two phases, one of which is Ag_2Te. There is, as yet, no definite evidence that a ternary compound with a composition $AgFeTe_2$ exists. C.Hilsum

10050 EFFECT OF PRESSURE ON THE RESISTANCE OF IODINE AND SELENIUM.
A.S.Balchan and H.G.Drickamer.
J. chem. Phys. (USA), Vol. 34, No. 6, 1948-9 (June, 1961).

The effect of pressure from 60 to over 400 kbar was measured on the resistance of selenium and iodine. Selenium exhibits a very rapid drop in resistance between 60 and 128 kbar; at 128 kbar it shows a discontinuous drop. At higher pressures its behaviour is apparently metallic. Iodine shows a rapid drop in resistance from 60 kbar to the region of 225-255 kbar where there is relatively abrupt change of slope. At higher pressures the change in resistance with pressure is much smaller. It is interesting to note that the optical energy gap of selenium extrapolates to zero at about 130 kbar, while the optical gap for iodine extrapolates to zero at 240 kbar.

10051 ELECTRICAL PROPERTIES OF STANNIC OXIDE FILMS. I.Imai.
J. Phys. Soc. Japan, Vol. 15, No. 5, 937 (May, 1960).

The electrical conductivity, Hall constant and Seebeck coefficient of stannic oxide films were measured from liquid nitrogen to room temperature. The results are analysed in terms of free-electron theory to yield a scattering index of p = 3. J.B.Birks

Semiconductor Devices

10052 CAPACITIVE CHARACTERISTICS OF p-n JUNCTIONS. B.M.Vul.
Fiz. tverdogo Tela (USSR), Vol. 3, No, 1, 204-5 (Jan., 1961).
In Russian.

The simplest case of a junction diode is considered, assuming the whole transport mechanism to be of such low resistivity as to justify the whole potential across the electron region only. The analysis is based on the Poisson relationship between charge density, distance in the n-region to the p-boundary and dielectric constant, and a formula for C in the above terms and the width and area of the junction and applied potential are derived. [English translation in: Soviet Physics-Solid State (USA)]. A.Landman

10053 TEMPERATURE DEPENDENCE OF THE TUNNEL CURRENT IN P-N JUNCTIONS.
B.M.Vul, A.P.Shotov and S.P.Grishechkina.
Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 667-9 (Feb., 1961).
In Russian.

The temperature dependence of the current-voltage characteristics of Ge diodes heavily doped with As, Ga or Sb was measured ($-196^\circ < T < 70^\circ C$) and the As results explained qualitatively. With an As concentration of 3.7×10^{19} cm^{-3}, the I_{max} was nearly independent of temperature; at higher concentrations it decreased and at lower concentrations it increased with increasing temperature. The effects appear to depend on the type of impurity as well as the concentration. [English translation in: Soviet Physics—Solid State (USA)]. D.J.Huntley

10054 ELECTRON BOMBARDMENT DAMAGE IN SILICON ESAKI DIODES.
R.A.Logan, W.M.Augustyniak and J.F.Gilbert.
J. appl. Phys. (USA), Vol. 32, No. 7, 1201-5 (July, 1961).

The excess current in silicon Esaki diodes was shown to be a sensitive indicator of the density and distribution of states introduced into the forbidden gap by electron bombardment. Both the effects of bombardment and the annealing properties of the radiation damage were found to depend upon the specific donor in the n-type region of the diode. The average bombardment dose of 1-MeV electron/cm^2 needed to increase the excess current density by 1 amp/cm^2 at a bias of 0.3 V is 1.2×10^{16} for P-doped diodes and 0.8×10^{16} for Sb- or As-doped diodes. Upon annealing in an inert atmosphere, at temperature in the range 300°-400°C, the bombarded diode is restored to its original characteristics. While the annealing studies reveal novel interactions, they show considerable similarity with other work where the radiation damage was monitored by carrier lifetime or conductivity measurements. Structures observed in the I—V characteristics during the annealing indicate that the bombardment-induced levels at $E_V+0.27$ and $E_V+0.06$ are due to pairing of a primary defect (probably a vacancy) with an arsenic and a phosphorus impurity atom, respectively.

10055 SATURATION CURRENTS AT N-TYPE SILICON AND GERMANIUM ELECTRODES IN CHEMICAL ETCHING SOLUTIONS. D.R.Turner.
J. Electrochem. Soc. (USA), Vol. 108, No. 6, 561-3 (June, 1961).

The anodic saturation current density of an n-type Si or Ge electrode is considerably larger in chemical etching solutions than in nonetching solutions because the chemical etching process produces excess holes at the surface of the semiconductor. The rate at which these excess holes become available to the electrolytic anodic dissolution reaction is proportional to the chemical etching rate, the surface recombination velocity, and the anodic multiplication factor. Three practical applications of the experiment are indicated: (a) a monitor for chemically etching semiconductors; (b) a tool to study the process of chemical etching; and (c) a simple method for fluoride ion analysis.

AN ULTRASONIC RECEIVER BASED ON A SEMICONDUCTING THERMISTOR. See Abstr. 9455

Photoconductivity

10056 P-TYPE PHOTOCONDUCTIVITY AND INFRARED QUENCHING IN ELECTRON-BOMBARDED CdS.
B.A.Kulp and R.H.Kelley.
J. appl. Phys. (USA), Vol. 32, No. 7, 1290-2 (July, 1961).

A platelet-type crystal of pure CdS 46 μ thick was irradiated first with 100 keV electrons to reduce the number of sulphur interstitials, then for 400 μA-hr/cm^2 with 150 keV electrons to produce an excess of sulphur vacancies. At room temperature, photoconductuve peaks were observed at 0.67, 0.9, and 1.4 μ. Point-contact rectification was used to determine that the 0.67 μ peak was due to electronic conduction and the 0.9 and 1.4 μ peaks were due to hole conductivity. A "quenching" experiment, i.e., simultaneous irradiation with bandgap light and infrared light of variable wavelength, at room temperature shows the 0.67 μ photopeak and quenchi at 0.9 and 1.4 μ. In a separate experiment, the 1.4 μ quenching band was partially removed from a platelet-type crystal by bombarding at 100 keV. This bombardment also removed edge emission from this crystal. The temperature dependence of the 1.4 μ quenching band and of the intensity of edge emission as observed by Reynolds suggests that the centres for edge emission and for the 1.4 μ quenching bands are actually the same centre, namely the sulphur interstitial in different ionization states.

10057 FLUCTUATIONS, NEUTRAL TRANSPORT, AND THE PHOTOCONDUCTIVE PROCESS IN CdS.
R.J.Robinson and J.J.Brophy.
Physica (Netherlands), Vol. 26, No. 6, 440-2 (June, 1960).

New evidence for neutral energy transport in CdS, obtained from electrical noise measurements, is reported. Also, from current noise spectra, an additional generation or relaxation process is shown to arise in photodiffusion experiments. From noise intensity, decay constant and conduction band lifetime measurements, the possibility is suggested that the dynamics of the photoconductive process are different under photodiffusion conditions i.e. different from those for photoconductivity induced under constant illumination. A.J.Fox

10058 ON THE PHOTOCONDUCTIVITY OF CdS FILMS PRODUCED BY SINTERING. L.Gombay and M.Zöllei.
Acta. phys. chem. Szeged. (Hungary), Vol. 5, No. 1-2, 26-33 (1959).
In German.

The relative proportion (δ) of photoelectrons in the conduction band was measured as a function of the intensity of illumination. This was determined for both undoped and Cl doped CdS films by measuring the relative variation in the resistivity with the intensity of illumination. The results were found to fit an empirical relationship for which (δ) is of the form $th(E_0 Q)$ instead of the more usual form $E_0/b\ [\ln(1 + bQ)]$; where Q is the intensity of the incident radiation and E_0 is the initial value of δ. A.J.Fox

10059 ANALYSIS OF PHOTOJUNCTIONS FORMED BY DIFFUSING COPPER INTO INSULATING CADMIUM SULFIDE CRYSTALS. R.R.Bockemuehl, J.E.Kauppila and D.S.Eddy
J. appl. Phys. (USA), Vol. 32, No. 7, 1324-30 (July, 1961).

A study of the observed photovoltaic, photorectification, and fiel effect modulation properties of junctions formed by diffusing copper into photoconductive, dark-insulating CdS crystals shows that two potential barriers are produced, one at the surface, the other in the crystal bulk. A transition from a double space charge dipole to a single separated dipole occurs at a reverse bias of less than 1V. A corresponding transition from a primary to a secondary photocurren process results. Values for the drift mobility of holes ranging from 10^{-5}-10^{-2} cm^2/V sec were derived from field effect measurements and found to be proportional to illumination intensity at the infrared quenching wavelengths.

10060 AVALANCHE BREAKDOWN IN CdS SINGLE CRYSTAL. S.Iizima and M.Kikuchi.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1345 (July, 1960).

Avalanche breakdown was induced near a non-ohmic silver contact on the CdS crystal. The breakdown could be triggered and quenched by illuminating the crystal with visible and infrared light. The voltage—current characteristics of a basic cell are given. W.G.Townsend

10061 PHOTOCONDUCTIVITY OF Cd—ZnS MIXED CRYSTAL. M.Kikuchi and S.Iizima.
J.Phys. Soc. Japan, Vol. 15, No. 2, 357 (Feb., 1960).

The peak in the photoconduction excitation spectrum corresponding to the absorption edge is shifted to shorter wavelengths when ZnS is added to CdS to form a single mixed crystal, indicating that the band gap may thus be varied. J.B.Birks

10062 "SUB-THRESHOLD" PHOTOCURRENTS OF HIGH-QUANTUM YIELD IN 9,10-DICHLOROANTHRACENE.

Bree and W.G.Schneider.
chem. Phys. (USA), Vol. 34, No. 4, 1453-5 (April, 1961).

Photoconduction response peaks were observed at lower
oton energies than that of the first exciton level, but absorption
s negligible in the same region. Response in the 10 000-15 000
$^{-1}$ region is ascribed to release of trapped charges in the crystal,
ile in the region of 20 000 cm^{-1} it is assumed to be due to exciton
ssociation. G.F.J.Garlick

10063 A NEW NEGATIVE PHOTOCONDUCTIVITY EFFECT IN A MAGNETIC FIELD.

A.Grinberg, S.R.Novikov and S.M.Rȳvkin.
kl. Akad. Nauk SSSR, Vol. 136, No. 2, 329-31 (Jan. 11, 1961).
Russian.

For abstract, see Abstr. 5026 of 1961. [English translation
Soviet Physics—Doklady (USA), Vol. 6, No. 1, 49-50 (July, 1961)].

10064 PHOTOCONDUCTIVITY IN NICKEL DOPED GERMANIUM. Y.Furukawa.

Phys. Soc. Japan, Vol. 15, No. 2, 353 (Feb., 1960).

The steady-state intrinsic photoconductivity in nickel-doped
h-resistivity germanium was measured at high electric fields,
to 10^3 V cm^{-1}, to examine the effects of contacts on the photo-
nductivity. Two different types of contact were considered; they
re formed by soldering indium onto etched and ground surfaces of
specimen respectively. The results are discussed qualitatively.
A.J.Fox

10065 THE EFFECT OF ADSORBED OXYGEN ON THE PHOTO-E.M.F. OF LEAD SULPHIDE LAYERS.

Ya.Berlaga and T.T.Bȳkova.
z. tverdogo Tela (USSR), Vol. 2, No. 12, 3045-7 (Dec., 1960).
Russian.

The photo-e.m.f. of freshly prepared polycrystalline layers of
S amounted to several millivolts. Such layers were of n-type.
nsitization by heating to 500°-600° C caused sorption of oxygen
d, depending on the amount of oxygen adsorbed, the layers either
mained n-type or were converted to p-type conduction. This may
ve produced p—n junctions at grain boundaries and these junctions
y have been responsible for the observed high photo-e.m.f.
everal volts) after sensitization. [English translation in: Soviet
ysics—Solid State (USA), Vol. 2, No. 12, 2705-6 (June, 1961)].
A.Tybulewícz

10066 PHOTOCONDUCTIVITY IN TERNARY SULPHIDES.

J.A.Beun, R.Nitsche and M.Lichtensteiger.
ysica (Netherlands), Vol. 26, No. 8, 647-9 (Aug., 1960).

Single crystals of $ZnIn_2 S_4$, $CdIn_2 S_4$ and $HgIn_2 S_4$ were prepared
precipitation from the vapour phase. These sulphides had
eviously been made in the polycrystalline state only. Infrared
sorption, dark- and photo-conductivity and Hall effect measure-
ents were made. The photocurrent increases linearly with
ltage up to almost the breakdown voltage. A table for the 3
mpounds is given listing the wavelengths of the optical absorption
ge and those corresponding to maximum photo-current, of
sistivity, carrier mobility and density both in the dark and under
ted conditions of illumination and of the decay time of the
nduction after the illumination has ceased. R.Parker

0067 SPECTRAL RESPONSE OF SOLAR CELLS.

B.Dale and F.P.Smith.
appl. Phys. (USA), Vol. 32, No. 7, 1377-81 (July, 1961).

An analysis of the spectral response of a solar cell is given
ich includes the effect of the electric field present in the diffused
rface region. Results are presented which show the variation of
sponse with junction depth and with carrier lifetime in both
rface and bulk regions. By curve fitting, it is found that in a
ical silicon cell the bulk lifetime is in the range 1-15 μsec,
ile the surface region lifetime is between 10^{-9} and 10^{-10} sec.
mbardment with a total flux of 3.3×10^{14} electrons/cm^2 of
MeV electrons reduced the n region lifetime by a factor of
), and the p region lifetime by a factor of 6 in a particular case.

10068 THE REDUCTION OF OPTICAL REFLECTION BY COATING GERMANIUM PHOTORESISTORS, WITHOUT INCREASING THE RATE OF SURFACE RECOMBINATION.

F.R.Kessler.
Z. angew. Phys. (Germany), Vol. 13, No. 2, 72-4 (Feb., 1961).
In German.

A germanium photoresistor with low surface recombination velocity s was coated once with $PbCl_2$ and another time with Se in order to reduce the reflection loss. With $PbCl_2$ s increased by a factor of two but with Se remained unchanged so that the spectral sensitivity curve showed an increased sensitivity in the visible region. C.A.Hogarth

10069 OUTER PHOTOEFFECT AND DELAYED ELECTRON EMISSION OF ULTRAVIOLET-IRRADIATED SINGLE CRYSTALS OF KCl AND KBr. W.Klein, G.Schatz and K.Seeger.

Z. Phys. (Germany), Vol. 160, No. 4, 443-52 (1960). In German.

The photoelectric response was measured over the photon range 0.5 to 3.6 eV together with delayed electron emission. For pure KCl, excitation at 100°K and at energies $>$ 4 eV gave photoelectric emission in the visible showing a decay with time, the centres responsible showing thermal bleaching at 100°K. The trapped electrons involved in delayed emission are, however, stable. In both KCl and KBr the photoelectric effects and the delayed electron emission seem to be unrelated. G.F.J.Garlick

Thermoelectric Properties

10070 EFFECT OF CHARGED DISLOCATION ON THE THERMOELECTRIC POWER OF SEMICONDUCTORS.

T.Ohta.
J. Phys. Soc. Japan, Vol. 15, No. 1, 197 (Jan., 1960).

Edge dislocations in n-Ge act as a line of negative charge surrounded by a cylinder of positive space charge; the effect of these on the thermoelectric power are computed theoretically. In general the effects are small but for a small value of the difference in concentrations of dislocations and impurities and at the impurity-to-intrinsic transition range of temperature, larger effects would be expected. C.A.Hogarth

10071 THE THERMO-ELECTRIC PROPERTIES OF CHROMIUM STEELS AFTER VARIOUS HEAT TREATMENTS.

I.A.Kuznetsov.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 191-9 (Aug., 1960). In Russian.

Hardness, impact strength, thermo-e.m.f., E, electrical resistivity, coercive force, maximum magnetic permeability, and intensity of saturation magnetization, I_s, of several Cr steels, containing 1.08-1.5% C and 0.58-11.9% Cr, were measured in order to study the relationship between these properties and the constitution and structure of Cr steels, as determined by their composition and thermal history. It was established that all the properties studied depend to a great extent on the heat treatment applied and on the resultant structure. Since E and I_s were affected in a similar manner by the variation of the hardening and tempering temperatures, and since E of the steels studied (both in the hardened and annealed condition) was also greatly affected by their composition, it was concluded that this property provides a convenient means for controlling the quantity of the residual austenite in Cr steels and for quick sorting of alloys of this type. In some cases, I_s of steels tempered at temperatures above 300°C was lower than that of specimens tempered at 260°-300°C; this effect was attributed to various carbide transformations taking place during tempering. M.H.Sloboda

10072 ANOMALOUS THERMOELECTRIC PROPERTIES OF GADOLINIUM SELENIDE. R.C.Vickery and H.M.Muir.

Nature (GB), Vol. 190, 336-7 (April 22, 1961).

It is suggested that when a mixture of 90% Ga_2Se_3 and 10% GaSe is quenched from 1800°C the material formed is a single phase metastable compound. This material has a very high thermoelectric figure of merit, and the interrelations between the thermoelectric power, the resistivity and the thermal conductivity are anomalous. An attempt is made to explain the anomaly. C.Hilsum

Dielectric Properties

10073 DIELECTRIC RELAXATION PHENOMENA IN SELENIUM.

W.Ludwig and F.Eckart.

Z. Phys. (Germany), Vol. 162, No. 2, 127-41 (1961). In German.

Measurements over the frequency range 10^3-10^6 c/s at temperatures between −160 and 40°C are reported. The samples were polycrystalline hexagonal Se doped with up to 0.1% Br. The loss tangents, after allowing for the d.c. conductivity, show anomalous dispersion peaks whose activation energy agrees with that of the d.c. conductivity. The results are discussed in terms of an ionic jump mechanism, which is thought to be responsible both for conduction and the relaxation effect. K.W.Plessner

10074 DISPERSION OF THE PERMEABILITY AND PERMITTIVITY OF ARTIFICIAL DIELECTRICS IN THE FREQUENCY RANGE 500-35000 Mc/s.

I.A.Deryugin and M.A.Sigal.

Zh. tekh. Fiz. (USSR), Vol. 31, No. 1, 100-8 (Jan., 1961). In Russian.

The authors made measurements on paraffin oils containing copper powders of various grades. The finest powders were smaller than the penetration depth of the fields used. The dielectric constant results were in qualitative agreement with the theory of Levin, the differences at high copper concentrations being ascribed to asphericity of the powder particles and to the inhomogeneity of their distribution. It was found that the Clausius–Mosotti relation was satisfied for low copper concentrations. The dielectric loss angle was zero for all frequencies and concentrations investigated. The magnetic permeability as a function of copper concentration agreed with theory. It was found that $|\mu| < 1$ because of the screening effect of eddy currents. The magnetic loss angle was proportional to copper concentration and was larger than the theoretical value. [English translation in: Soviet Physics–Technical Physics (USA)]. M.G.Priestley

10075 BISMUTH TITANATE. A FERROELECTRIC.

L.G.Van Uitert and L.Egerton.

J. appl. Phys. (USA), Vol. 32, No. 5, 959 (May, 1961).

Single crystals of $Bi_4Ti_3O_{12}$ were grown from a melt containing excess Bi_2O_3. These showed ferroelectric hysteresis loops, the saturation polarization being about 3.5 μC cm^{-2}. No phase transition was detected optically until 643°C, when the crystals lost their birefringence. K.W.Plessner

10076 SURFACE LAYERS ON BARIUM TITANATE SINGLE CRYSTALS ABOVE THE CURIE POINT.

H.Schlosser and M.E.Drougard.

J. appl. Phys. (USA), Vol. 32, No. 7, 1227-31 (July, 1961).

Dielectric dispersion measurements were carried out on crystals of different thicknesses at temperatures above the Curie point ranging up to 180°C. In the high-frequency range of the measurements (100 kc/s), the measured dielectric constant of thin crystals is consistently much smaller than that of thick samples. The effect is ascribed to the presence of a layer of low dielectric constant on the surface of the crystals, with a capacitance of the order of 0.5 μf/cm^2 in the temperature range explored. The relaxation time of this surface layer is found to be at least 10^{-4} sec at 120°C on crystals which have not been "aged" recently.

10077 SOME PROPERTIES OF X-RAY DAMAGED ROCHELLE SALT.

K.Okada.

J. Phys. Soc. Japan, Vol. 15, No. 2, 363-4 (Feb., 1960).

Measurements were made of the properties of "a"-cut Rochelle Salt crystals damaged by exposure to 50 kV X-rays. Biased hysteresis loops were observed in poled crystals, and symmetric double hysteresis loops in completely unpolarized specimens. The domain clamping responsible for these effects was observed directly by optical methods on crystals damaged in a selected region. Permittivity measurements on crystals which exhibited a symmetric double hysteresis loop showed a shift of upper and lower Curie temperature with moderate biasing field in the opposite direction to that observed in undamaged crystals, i.e., similar to the change in an antiferroelectric. In strong fields, the damaged crystals behaved in the same manner as virgin specimens. L.E.Cross

10078 THE PIEZOELECTRICITY AND ELECTROSTRICTION OF ROCHELLE SALT.

G.Schmidt.

Z. Phys. (Germany), Vol. 161, No. 5, 579-603 (1961). In German.

The piezoelectric constants g and the electrostrictive constants Q were determined by polarization and displacement measurements The temperature range covered the ferroelectric region and temper tures a little beyond this. A d.c. field was applied in the ferroelectric range to align the domains. The curve of g_{14} versus tempe ture was found to be continuous through the ferroelectric region without any anomalies at the two Curie points. With certain reservations the same applied to Q_{11}. g_{12}, g_{13}, Q_{12}, and Q_{13}, however, showed certain anomalies on approaching the Curie points and in the ferroelectric state, the Q's in particular varying with the d.c. field. It is concluded that the existence of the ferroelectric state in Rochelle salt cannot be regarded simply as a consequence of the particular temperature variation of the electrical parameters of the crystal, but must be ascribed to a change in the structure of the crystal. K.W.Plessn

10079 THE DIFFERENT FERROELECTRIC PROPERTIES IN DIFFERENT REGIONS OF ROCHELLE SALT CRYSTAL

H.E.Müser and H.G.Unruh.

Z. Phys. (Germany), Vol. 162, No. 3, 313-28 (1961). In German.

Very accurate measurements of the Curie points have shown small systematic differences between different regions of the same crystal, the regions being related to the orientation of the original seed crystal. A small dependence on temperature of crystal growth was also found. While the nature of the impurities in the crystals was not known, experiments with purposely added ammonium tartrate pointed to a possible explanation in the preferential deposition of impurities in certain regions during growth. K.W.Plessne

10080 180° DOMAIN WALL MOTIONS IN $BaTiO_3$ CRYSTAL.

K.Husimi.

J. Phys. Soc. Japan, Vol. 15, No. 4, 731 (April, 1960).

Crystals were etched with KCl to show domain wall movement after application of a pulsed electric field of 5 kV cm^{-1}. A.R.Stokes

10081 ELECTRICAL PROPERTIES OF SOME MIXED FERRITES IN ALTERNATING ELECTRIC FIELDS.

E.V.Sinyakov and V.P.Avramenko.

Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 411-15 (Feb., 1961). In Russian.

Reports measurements of the temperature dependence of permittivity and losses in 10^6-10^7 c/s fields and the dependence of the same properties on composition of four mixed ferrite systems: (100-n)$NiFe_2O_4$–n$CoAl_2O_4$; (100-n)$NiFe_2O_4$–n$NiAl_2O_4$; (100-n)$NiFe_2O_4$–n$NiMn_2O_4$; (100-n)$CoFe_2O_4$–n$ZnFe_2O_4$, where n = 0.5–40 mol.%. Both the polarization and the losses are of relaxatio type and are due to local electron exchange between divalent and trivalent metal ions at identical lattice sites. [English translation in: Soviet Physics–Solid State (USA)]. S.Chomet

10082 ELECTRIC BREAKDOWN STRENGTHS OF SINGLE AND LAMINATED FILMS OF VINYL CHLORIDE-ACETATE.

R.G.Greenler and R.M.Kay.

J. appl. Phys. (USA), Vol. 32, No. 7, 1252-5 (July, 1961).

The electric breakdown strengths of thin, unsupported vinyl chloride-acetate films in the thickness range of 1200 to 50 000 Å were measured. No dependence of breakdown strength on thickness is found in this region. Composite films composed of alternate layers of plastic film and thin conducting layers of silver show essentially the same breakdown strength as do single films. Five- and six-layer laminates which do not contain metal layers show a breakdown strength greater by a factor of 2 than that of single films of the same total thickness.

10083 PIEZOELECTRICITY OF QUARTZ FOR FINITE STRAIN.

S.Machlup and M.E.Christopher.

J. appl. Phys. (USA), Vol. 32, No. 7, 1387-91 (July, 1961).

In order to obtain an estimate of the maximum piezoelectric polarization possible for alpha quartz, the principal piezoelectric coefficient is calculated on the basis of a hard-sphere, rigid-ion model. The result, obtained by purely geometrical reasoning (including an ad hoc geometrical constraint), fits the measured value of e_{11} with an "effective ionic charge" of one-sixth the free ionic charge. Extension of the calculation to finite compressive strain yields a maximum polarization of 3.4 μcoul/cm^2 at a 34% strain. (Compare with $e_{11} = 16.7$ μcoul/cm^2 per unit strain.) For higher strains the polarization drops off rapidly, but the model becomes inconsistent for strains greater than 43%. A test for more general validity of the model, by obtaining directly the ratio of the two independent piezoelectric coefficients, e_{14}/e_{11}, yields seven times the measured ratio.

10084 MEASUREMENT OF PIEZOELECTRIC CONSTANTS OF A CdS CRYSTAL. T.Tanaka and S.Tanaka.

. Phys. Soc. Japan, Vol. 15, No. 4, 726 (April, 1960).

The constants determined were $d_{33} = 7.7 \times 10^{-8}$ and $_{31} = 4.6 \times 10^{-8}$ c.g.s. units. K.W.Plessner

10085 PIEZORESISTIVITY IN SEMICONDUCTIVE BARIUM TITANATES. O.Saburi.

. Phys. Soc. Japan, Vol. 15, No. 4, 733-4 (April, 1960).

A large negative peak in the piezoresistance coefficient was bserved near the Curie temperature of each of the $(Ba, Sr)TiO_3$ ompositions tested A close correlation with the temperature co-fficient of resistance suggested an explanation in terms of the hift in Curie temperature due to applied pressure. Agreement with xperiment is good. K.W. Plessner

OPTICAL PROPERTIES OF SOLIDS

(Including X-ray Spectra)

10086 OPTICAL PROPERTIES OF SOOT. R.C.Millikan.

. Opt. Soc. Amer., Vol. 51, No. 6, 698-9 (June, 1961).

The extinction coefficient of soot in flames is known to vary ith the n-th power of the wavelength. n was found to be indepen-ent of particle size, over the range studied, and to be unaffected y collection on a cool plate (but not if the plate became heated). depended markedly on chemical composition of the soot particles, ncreasing with hydrogen content; a plot of n against ydrogen/carbon ratio is given. A.G.Gaydon

10087 OPTICAL CONSTANTS AND REFLECTANCE AND TRANSMITTANCE OF EVAPORATED ALUMINUM IN THE VISIBLE AND ULTRAVIOLET. G.Hass and J.E.Waylonis.

. Opt. Soc. Amer., Vol. 51, No. 7, 719-23 (July, 1961).

Presents new measurements of evaporated films produced from he purest grade of aluminium with extremely fast evaporation at bout 10^{-5} mm Hg. The optical constants were determined by Drude's polarimetric method from opaque films and by reflectance, ransmittance, and true thickness measurements of semitransparent ilms. The following results were obtained.

λ (mμ)	220	260	300	340	380	436	492	546	578	650
n	0.14	0.19	0.25	0.31	0.37	0.47	0.64	0.82	0.93	1.30
k	2.35	2.85	3.33	3.80	4.25	4.84	5.50	5.99	6.33	7.11
R%	91.8	92.0	92.1	92.3	92.6	92.6	92.2	91.6	91.5	90.7

or extremely fast evaporated films the optical constants were ound to remain unchanged down to film thicknesses of less than 00 A. Data are given on the reflectance and transmittance of semi-ransparent aluminium films on glass and fused quartz as a function f wavelength from 220 to 650 mμ.

10088 THE TEMPERATURE DEPENDENCE OF THE OPTICAL CONSTANTS OF SOLID METALS. M.Otter.

. Phys. (Germany), Vol. 161, No. 5, 539-49 (1961). In German.

The optical constants of Cu, Ag, and Au in the form of half cube ingle crystals were measured in the visible region between room emperature and the melting points. The optical constants of molten u and Au at the melting point were also determined. The optical roperties resulting from conduction electrons were investigated, he relaxation time decreasing with increasing temperature. In the ransition to characteristic absorption the sign of the temperature oefficient for the real and imaginary parts of the dielectric con-tant changes. For the molten specimens this is not so. C.A.Hogarth

10089 REFLECTION AND TRANSMISSION COEFFICIENTS AT OBLIQUE INCIDENCE FOR A THIN FILM OF SILVER.

.Danis and J.P.David.

C.R. Acad. Sci. (France), Vol. 252, No. 14, 2090-2 (April 5, 1961).

n French.

Observations were made at wavelengths of 4358 A, 5461 A and 780 A for angles of incidence from 15° to 65°. For thicker layers he results agree with theoretical predictions, taking the optical onstants as those for bulk silver. For thin layers the agreement s not so good. C.Hilsum

10090 REFLECTION AND EMISSION OF POLARIZED LIGHT IN ZnS AND CdS.

J.L.Birman, H.Samelson and A.Lempicki.

GT & E Res. Developm. J. (USA), Vol. 1, No. 1, 2-15 (Jan., 1961).

Results are presented on the reflection of polarized light by single crystals of structurally pure cubic and hexagonal ZnS in the region of the absorption edge. Two reflection anomalies are found in cubic, and three in hexagonal, ZnS. Each anomaly corresponds to the creation of an exciton. From their energies the valence band splittings in cubic and hexagonal ZnS are estimated to be 0.068 eV (cubic), 0.027 and 0.084 eV (hexagonal), at 77°K. The temperature dependence of the polarization of the edge fluorescence in CdS is reported. In the temperature range of 100 to 180°K, these results agree with a theory based on the Lambe–Klick model proposed by Hopfield (1958). At lower temperatures the polarization becomes essentially temperature independent. A revised Lambe—Klick theory is presented which can account for both high- and low-temperature results. The temperature dependence of polarization of red fluorescence (~6500 A) of CdS:Ag:Cl and CdS:Ag:Ga, and of blue fluorescence (~4500 A) of ZnS:Cu:Cl is also reported. None of these effects are consistent with predictions of the Lambe—Klick model. Slight effects on polarization caused by different coactivators in CdS:Ag (e.g. Ga and Cl) are noted.

10091 A STUDY OF THE OPTICAL PROPERTIES AND STRUCTURE OF TITANIUM DIOXIDE LAYERS.

T.N.Krȳlova and G.O.Bagdȳk'ȳants.

Optika i Spektrosk. (USSR), Vol. 9, No. 5, 644-7 (Nov., 1960).

In Russian.

Reports measurements of the wavelength dependences (λ = 400-700 mμ) of the reflection coefficient and the refractive index of amorphous TiO_2 layers prepared from $Ti(OC_2H_5)_4$ solution. The temperature dependence of the refractive index in the 500-550 mμ region and of the electron-diffraction patterns showed that the layers begin to crystallize as anatase at 300°-350°C. [English translation in: Optics and Spectrosc. (USA), Vol. 9, No. 5, 339-41 (Nov., 1960)]. A.Tybulewicz

10092 CHANGES OF REFRACTIVE INDEX OF QUARTZ PLATES DURING ELECTROLYSIS.

H.H.Pfenninger and F.Laves.

Naturwissenschaften (Germany), Vol. 48, No. 1, 22-3 (1961).

In German.

If quartz plates are placed between Ag or Cu electrodes during electrolysis, a change of refractive index can be shown by interferometry. Measurements suggest that the change arises from the substitution of Ag or Cu ions for alkali ions in the quartz. R.W.Fish

10093 OPTICAL PROPERTIES OF ORIENTED POLYSTYRENE. R.S.Stein.

J. appl. Phys. (USA), Vol. 32, No. 7, 1280-6 (July, 1961).

The orientation of a monomer unit of a polystyrene molecule is specified in terms of seven orientation functions, of which five are independent in the general case. The birefringence and infrared dichroism are expressed in terms of these orientation functions. The expression for infrared dichroism is dependent on the angle which the direction of dipole moment change for the normal mode of vibration concerned makes with the axes of the molecule. Experimental possibilities for determining these orientation functions are discussed.

HIGH VOLTAGE MEASUREMENT BY A.D.P. CRYSTAL PLATE. See Abstr. 9516

10094 OPTICAL STUDIES OF THE BAND STRUCTURE OF InP. M.Cardona.

J. appl. Phys. (USA), Vol. 32, No. 5, 958 (May, 1961).

Reflectivity measurements on polished InP samples were carried out, before and after etching, at 90° and 296°K. A peak in the reflectivity at 3.15 eV is attributed, by analogy with other semiconductors, to transitions between the valence band and conduction band extrema at the edge of the Brillouin zone along the (111) direction. At low temperature the peak is partially resolved into a doublet with a separation of about 0.16 eV due to spin-orbit splitting in the valence band. The temperature coefficient of the energy gap in question is $-4.2\ 10^{-4}$ eV/deg, which is the same as that for the same gap in Ge, and for the fundamental optical gap of InP. L.Pincherle

10095 REFLECTANCE OF OXIDIZED SILICON MONOXIDE FILMS DEPOSITED ONTO ALUMINIUM MIRRORS COMPARED WITH SILICON MONOXIDE EVAPORATED IN HIGH VACUA. J.F.Hall, Jr and R.C.Allen.
J. Opt. Soc. Amer., Vol. 51, No. 3, 367-8 (March, 1961).

The wavelength range 0.25 μ to 15 μ is covered. The results, which are given in graph form for various thicknesses of film, suggest that the "oxidized" films are not completely oxidized to SiO_2 but consist of mixtures of SiO, Si_2O_3 and SiO_2.
W.T.Welford

10096 OPTICAL PROPERTIES OF EVAPORATED InSb FILMS. R.F.Potter and G.G.Kretschmar.
J. Opt. Soc. Amer., Vol. 51, No. 6, 693-6 (June, 1961).

Polycrystalline films of InSb can be deposited on glass or cadmium sulphide substrates if the substrate is held at a temperature above the condensation temperature of the antimony and below the decomposition temperature of InSb. Measurements were made of the transmittance and reflectance of the films at wavelengths between 1 and 15 microns. Hall constant determinations show the films to be n-type, with about 10^{18} carriers per cm^3. C.Hilsum

10097 ON THE OPTICAL AND ELECTRICAL PROPERTIES OF METALS ON THE BASIS OF MEASUREMENTS ON VERY THIN EVAPORATED LAYERS. I. BEHAVIOUR OF THE OPTICAL ABSORPTION OF COPPER, SILVER AND GOLD IN THE RANGE 0.3-5.5 eV FOR DIFFERENT CONDITIONS OF EVAPORATION. W.Flechsig.
Z. Phys. (Germany), Vol. 162, No. 5, 570-605 (1961). In German.

Transmission measurements are reported, in the visible and in the infrared, on layers of various thicknesses (1-100 atomic layers) for different evaporation methods, and with and without impurities. Several anomalies are discussed. There is evidence for a resonance effect which increases the effective field inside the layer. In general the theoretical interpretation is satisfactory.
L.Pincherle

10098 ON IMPURITY EFFECTS IN THE INFRA-RED AND AT ULTRA-HIGH RADIO FREQUENCIES IN SOLIDS.
B.Szigeti.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 9-10 (1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). A theoretical investigation of the effect of impurity atoms on the vibrational absorption spectrum of nonpolar crystals. Exact solutions were obtained for a one dimensional model.
J.N.Hodgson

10099 SPECTRUM, ZEEMAN EFFECT AND ELECTRON TERMS OF TRIVALENT ERBIUM IN CRYSTALLINE SALTS. III. TERM SCHEME AND EIGEN-STATES OF ER^{3+} IONS.
H.G.Kahle.
Z. Phys. (Germany), Vol. 161, No. 5, 486-95 (1961). In German.

For Pts I and II see Abstr. 1165 of 1961. The terms of Er^{3+} ions are calculated by matrix methods involving electron Coulomb repulsion and spin-orbit coupling, for the configuration f^{11}. J values and g factors agree with those found experimentally.
G.F.Lothian

10100 ABSORPTION SPECTRA NEAR 0.65μ OF ERBIUM FERRITE WITH GARNET STRUCTURE.
B.Dreyfus, J.Verdone-Thullier and M.Veyssié-Counillon.
C.R. Acad. Sci. (France), Vol. 252, No. 13, 1928-30 (March 27, 1961). In French.

The absorption of the Er^{3+} ion in erbium garnet was studied in the region of 15 400 cm^{-1}. Spectra taken at three temperatures, 4°K, 78°K and 293°K, lead to the conclusion that the three bands observed are due to $^4I_{15/2} \rightarrow {}^4I_{9/2}$ transitions. The $^4I_{15/2}$ state represents the fundamental level and the effect of the crystal field splits this into three $^4I_{9/2}$ sublevels. D.L.Greenaway

10101 ANALYSIS OF THE ABSORPTION AND FLUORESCENCE SPECTRUM OF $NdCl_3$ DILUTED WITH $LaCl_3$.
E.Y.Wong.
J. chem. Phys. (USA), Vol. 34, No. 6, 1989-93 (June, 1961).

The Stark splitting of the identified levels of Nd^{3+} in $LaCl_3$ were calculated by first-order perturbation. Intermediate coupling wave-functions and crystal-field interaction parameters reported by Judd were used. The calculated spectrum agrees with the spectrum observed by Carlson to 5 cm^{-1}.

10102 OPTICAL BLEACHING OF R-BANDS IN LiF CRYSTALS. D.Fukuda, A.Okuda and Y.Uchida.
J. Phys. Soc. Japan, Vol. 15, No. 3, 538-9 (March, 1960).

LiF coloured by 1 MeV electrons of intensity 10^8 rad produced bands at 320 mμ (R_1) and 380 mμ (R_2) which were most prominent when the irradiating temperature was 100°C. It is concluded from bleaching experiments that R_1 and R_2 bands arise from two transitions in the same centre. Dichroism of the R bands is also reported.
J.E.Caffyn

10103 POST-IRRADIATION EFFECT IN VISIBLE ABSORPTION SPECTRA OF POLYVINYL CHLORIDE SHEETS.
Y.Okada, T.Ito and A.Amemiya.
J. Phys. Soc. Japan, Vol. 15, No. 5, 938-9 (May, 1960).

Samples irradiated with 1 MeV electrons show absorption bands at 5700 and 6300 A. The colour changes from blue to green after irradiation. A possible mechanism is discussed.
R.F.Barrow

10104 OPTICAL ABSORPTION OF LOCALISED EXCITON IN KCl:I AND NaCl:I SINGLE CRYSTALS.
K.Fukuda, R.Kato, K.Nakamura and Y.Uchida.
J. Phys. Soc., Japan, Vol. 15, No. 7, 1344-5 (July, 1960).

Absorption bands at 188 mμ and 182 mμ due to I^- in KCl:I and NaCl:I were obtained using a vacuum u.v. spectrophotometer. These were displaced from the fundamental absorption edge of the host crystal by more than the difference in the electron affinities of Cl and I.
J.E.Caffyn

10105 ABSORPTION BAND DUE TO A PRESENCE OF IMPURITY BROMINE IN KCl CRYSTALS.
K.Kobayashi and T.Tomiki.
J. Phys. Soc. Japan, Vol. 15, No. 7, 1350-1 (July, 1960).

Absorption at the band edge of KCl is related to bromine impurity which gives a band at 7·1 eV with half width of approximately 0·18 eV and oscillator strength of 0·07.
G.F.J.Garlick

10106 ON THE ABSORPTION OF MANGANESE — ACTIVATED CORUNDUM SINGLE CRYSTALS.
W.Kleber, H.Peibst and I.Rheinhold.
Z. phys. Chem. (Germany), Vol. 216, No. 1-4, 98-117 (1961). In German.

Detailed study of the absorption at and near the fundamental absorption edge of corundum crystals made by the Verneuil flame-fusion process. Activation with manganese (and also with other metallic impurities) gives rise to absorption bands beyond the fundamental edge.
C.A.Hogarth

10107 INFRARED ABSORPTION OF α-$Ag_2Te_xS_{1-x}$. S.Miyatani.
J. Phys. Soc. Japan, Vol. 14, No. 11, 1634 (Nov., 1959).

Thin specimens of the material with different values of x were used to observe i.r. interference fringes and absorption effects. The results could not be explained in terms of a simple model involving energy independence of the electronic relaxation time.
I.Cooke

ELECTRICAL AND OPTICAL PROPERTIES OF GaAs—InAs ALLOYS. See Abstr. 10026

10108 PREDICTION OF X-RAY FLUORESCENT INTENSITIES AND INTERELEMENT EFFECTS. B.J.Mitchell.
Analyt. Chem. (USA), Vol. 33, No. 7, 917-21 (June, 1961).

A method for the accurate prediction of the intensities requires only the measurement of an element's intensity in a few key matrix materials. The variation in the intensity of the X-radiation with the atomic number of its matrix is generally inverse to the variation in its mass absorption coefficient. An intensity-matrix correlation, except for certain discontinuities, is a continuous-type curve from which previously unmeasured intensities may be read. The discontinuities are explained by the proximity of emission line and absorption edges. The complete pattern of intensities for molybdenum and iron in matrices from atomic number 20 to 90 was developed.

10109 THE INFLUENCE OF BRAGG REFLECTION ON INTENSITY IN X-RAY FLUORESCENCE ANALYSIS DIAGRAMS. E.Fuchs and P.Mecke.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 111-15 (March, 1961). In German.

Fluorescence spectra were obtained by irradiation of glass, NaCl, SiC and Al_2O_3 with tungsten radiation. The effect of tungsten L lines produced by scattering or Bragg reflection in these spectra are noted.
A.R.Stokes

10110 INVESTIGATION OF NARROW WELL IN NaI (Tl) FOR REDUCTION OF IODINE K X-RAY ESCAPE WHEN MEASURING CONTINUOUS X-RAY SPECTRA WITH COLLIMATED PHOTON BEAMS. E.R.Epp and H.Weiss.
Rev. sci. Instrum. (USA), Vol. 32, No. 6, 651-3 (June, 1961).

A technique described previously by Hettinger and Starfelt bstr. 17296 of 1960) consisted of confining the photon beam to a nall well in the crystal to reduce the solid angle through which dine K X-ray escape is possible. This technique was evaluated r tungsten characteristic radiation (~60 keV) and was reported provide a very substantial reduction in the escape peak. The esent paper describes an investigation of this technique at lower oton energies (10 to 60 keV). A tail was observed to appear on e low energy side of the photopeak of magnitude showing inverse pendence on photon energy. This distortion of pulse-height sponse is large enough to indicate that the well crystal technique unsatisfactory when making measurements of continuous X-ray ectra in the energy region where the escape of iodine K X-rays an important factor. The likely explanation is that light losses sociated with the well itself are responsible for the observed tails nce reflecting liners were not present. Introduction of a reflecting ner into the well was found to reduce the tail effect considerably.

uminescence

10111 LOW TEMPERATURE LUMINESCENCE AND ABSORPTION IN CRYSTALS OF BiI_3. R.I.Shekhmamet'ev.

iz. tverdogo Tela (USSR), Vol. 3, No. 2, 581-4 (Feb., 1961). Russian.

The absorption, diffuse reflection and luminescence of single ystal, and sublimed, BiI_3 were studied at 77°K. The results are ven in detail and are thought to be experimental evidence for a nnection between the emission edge and the structure of the ndamental absorption edge. [English translation in: Soviet nysics—Solid State (USA)]. K.N.R.Taylor

10112 A COMPARATIVE STUDY OF INFRARED LUMINESCENCE AND SOME OTHER OPTICAL AND ELECT-ICAL PROPERTIES OF ZnS:Cu SINGLE CRYSTALS.

Broser and H.J.Schulz.

Electrochem. Soc. (USA), Vol. 108, No. 6, 545-8 (June, 1961).

An attempt was made to fix the position of the optical transi-ons leading to infrared luminescence of ZnS:Cu within the general cture of electronic states of crystal phosphors. For this purpose, any optical and electrical properties, such as emission spectra the infrared and visible luminescence, excitation and quenching ectra of luminescence and photoconductivity as well as optical sorption spectra, were investigated on the same single crystal ithin a temperature range between 4° and 300°K. Most of the perimental results could be explained in terms of a relatively mple energy band scheme, which differs in some respects from ose published during the last years.

10113 BACKGROUND SPECTRA OF SOLIDS.

T.G.O.Berg.

Opt. Soc. Amer., Vol. 51, No. 6, 697-8 (June, 1961).

It is suggested that the similarity of luminescence emission aracteristics of a wide variety of materials may be the result of otochemical surface reactions with the atmospheric gases. G.F.J.Garlick

10114 LUMINESCENCE OF CHRYSENE POWDERS AND SOLUTIONS AT 77°K.

N.Nurmukhametov, E.G.Popova and N.S.Dokunikhin.

tika i Spektrosk. (USSR), Vol. 9, No. 5, 593-600 (Nov., 1960). Russian.

The Shpol'skii method [Uspekhi fiz. Nauk (USSR), Vol. 68, 51 959)] was used to study luminescence and absorption spectra of rysene solutions and powders at 77°K. A vibrational analysis of e spectra was compared with the results obtained by other thors. Spectroscopic and X-ray diffraction data were used to scuss the effect of inhomogeneities and deformations on the ectra of chrysene powders. [English translation in: Optics and ectrosc. (USA), Vol. 9, No. 5, 313-16 (Nov., 1960)]. A.Tybulewicz

10115 FLUORESCENCE OF MAGNESIUM AND CALCIUM PLATINOCYANIDE CRYSTALS. C.Moncuit.

R. Acad. Sci. (France), Vol. 252, No. 3, 397-9 (Jan. 16, 1961). French.

10116 LUMINESCENCE OF NON-ACTIVATED KI CRYSTALS.

N.N.Vasil'eva and Z.L.Morgenshtern.

tika i Spektrosk. (USSR), Vol. 9, No. 5, 676-7 (Nov., 1960). Russian.

Irradiation of KI with Co^{60} γ-rays at the temperature of liquid rogen produced a luminescence band (probably of exciton nature) 370 mμ; its half-width was 0.48 eV and it decayed exponentially with the time constant of 0.9 μsec. This band was observed in Tl-free KI and in KI:Tl crystals. [English translation in: Optics and Spectrosc. (USA), Vol. 9, No. 5, 357 (Nov., 1960)]. A.Tybulewicz

10117 LOW-TEMPERATURE LUMINESCENCE AND AFTERGLOW OF SILICA GELS.

A.I.Rezanov, I.A.Rȳbin and S.I.Masharov.

Izvestiya vȳsshikh uchebnȳkh zavedenii, Fizika (USSR), 1960, No. 4, 46-50. In Russian.

Reports the luminescence spectra of silica gel powder at the temperature of liquid nitrogen and at room temperature, the decay curve of afterglow at room temperature, and the spectrum of afterglow at −163°C. The exponential decay of afterglow is taken to indicate that luminescence of silica gel is due to discrete centres which are adsorbed water complexes attached to the gel surface in at least two points and bound to each other by hydrogen bonds. Fluorescence and afterglow of silica gel have many features in common with complex organic dye molecules in viscous media. A.Tybulewicz

10118 ZnS:Cu,Si PHOSPHORS.

A.Wachtel.

J. Electrochem. Soc. (USA), Vol. 108, No. 6, 534-40 (June, 1961).

Firing of ZnS + $(CH_2COO)_2Cu$ + SiS_2 causes incorporation of copper and promotes orange fluorescence under firing conditions whereby the "self-coactivated copper" emission is normally not obtained. This is accomplished by simultaneous incorporation of Si. It is proposed that silicon can replace vacancies or interstitial Zn atoms in proposed models for the orange-emitting copper centre. With high concentrations of Cu and Si, a ternary (Zn,Cu,Si)S forms which may show a deep-red fluorescence peaked at 840 mμ.

10119 THE EFFECT OF TEMPERATURE ON THE DECAY OF PHOSPHORESCENCE OF BORON PHOSPHORS.

M.D.Khalupovskii.

Optika i Spektrosk. (USSR), Vol. 9, No. 4, 525-7 (Oct., 1960). In Russian.

Reports a study of the effect of temperature on the decay laws in various regions of the phosphorescence spectra of boron phosphors activated with phthalic acid, salicylic acid, gallic acid, phthalic anhydride, phthalimide, phenanthrene, fluorescein, and uranin. [English translation in: Optics and Spectrosc. (USA), Vol. 9, No. 4, 274-5 (Oct., 1960)]. A.Tybulewicz

10120 EXCITON-INDUCED LUMINESCENCE IN KI/T1.

M.Tomura and Y.Kaifu.

J. Phys. Soc. Japan, Vol. 15, No. 7, 1295-1302 (July, 1960).

In a single crystal of KI:Tl, emissions from the Tl^+ ion and a certain impurity were observed under excitations of light in the first characteristic absorption band of KI. These exciton-induced luminescences were measured at various temperatures for specimens of several concentrations of the Tl^+ ion. The intensities of the exciton-induced luminescences attained saturated values at about liquid oxygen temperature. In consideration of the amount of energy transferred to the impurity, the saturated intensities of the exciton-induced luminescence from the Tl^+ ion were almost independent of the concentration of the Tl^+ ion in the range of $10^{18} \sim 10^{19}/cm^3$ and showed a quantum efficiency as high as 30%. Therefore the migration of an exciton through the crystal was confirmed.

10121 ULTRASONIC EFFECT ON ELECTROLUMINESCENT PANELS. J.Weissburg and P.Greguss, Jr.

Acustica (Internat.), Vol. 10, No. 3, 185-6 (1960).

Further comments on an earlier paper (Abstr. 18152 of 1960). S.T.Henderson

10122 ELECTROLUMINESCENCE OF GALLIUM PHOSPHIDE CRYSTALS. F.G.Ullman.

Nature (GB), Vol. 190, 161-2 (April 8, 1961).

Single crystal platelets of GaP were grown from solutions of P in Ga. Electroluminescence emission spectra were obtained at -100°C and room temperature. In undoped crystals peaks occurred at 5700A and 6500A, and in crystals containing Zn a peak occurred at 7000A. Crystals with more than 0.01% Zn did not luminesce. J.Franks

10123 ELECTROLUMINESCENCE OF ZnS : Cu : Mn POWDERS IN A CONSTANT ELECTRIC FIELD.

V.N.Favorin and G.S.Kozina.

Optika i Spektrosk. (USSR), Vol. 10, No. 1, 91-5 (Jan., 1961). In Russian.

Reports a study of d.c. electroluminescence and electrical conductivity of ZnS : Cu : Mn powders suspended in a mixture of synthetic resins. The electroluminescence brightness was found as a function of an applied voltage and of a conduction current passing through ZnS : Cu : Mn layers. The electroluminescence spectrum was obtained in constant and alternating fields. A mechanism is given which explains the results obtained. [English translation in: Optics and Spectrosc. (USA), Vol. 10, No. 1, 43-5 (Jan., 1961)].

A.Tybulewicz

10124 ON THE ELECTROLUMINESCENCE OF ZnS—ZnO MELTS. E.A.Schwager.

Z. Phys. (Germany), Vol. 163, No. 1, 44-55 (1961). In German.

Mixtures of ZnS, ZnO, $PbCO_3$ and CuO fused at 1900°C under N_2 pressure produce hexagonal polycrystalline material, whereas ZnS alone becomes cubic. Compared with normal sulphides these melts show the same photoluminescence except for the relative amplitudes of different bands, and the glow curves are similar. Electroluminescence from a solid plate of the material is similar to that from a 1100°C preparation. Observations are recorded on the temperature dependence of electroluminescence, on the light waves and the effect of infrared on them. There seems to be no voltage threshold in electroluminescence. S.T.Henderson

ELECTROLUMINESCENCE IN GALLIUM PHOSPHIDE. See Abstr. 10048

10125 THE SELF FLUORESCENCE OF THE NAPHTHALENE CRYSTAL AT 4.2°K. H.C.Wolf.

Naturwissenschaften (Germany), Vol. 48, No. 2, 43-4 (1961). In German.

The fluorescence of naphthalene in the region between 3200 and 3800 A is markedly different at or above 14°K from that observed at 4.2°K. The latter is the true spectrum, the former is due to the presence of 2-methyl naphthalene. S.T.Henderson

10126 OBSERVED PHOSPHORESCENCE AND SINGLET—TRIPLET ABSORPTION IN S-TRIAZINE AND TRIMETHYL-S-TRIAZINE. J.P.Paris, R.C.Hirt and R.G.Schmitt.

J. chem. Phys. (USA), Vol. 34, No. 5, 1851-2 (May, 1961).

10127 ON THE FLUORESCENCE OF PYRENE IN SOLID HYDROCARBONS. A.Schmillen.

Z. Naturforsch. (Germany), Vol. 16a, No. 1, 5-10 (Jan., 1961). In German.

The fluorescence changes due to interassociation of the molecules were used to examine the influence of various host lattices on the luminescence spectrum. The decay characteristics were measured for the system pyrene in fluorene. The luminescence decay of fluorene is little influenced by pyrene concentration. The decay of monomolecular pyrene fluorescence is relatively short but that of associated pyrene molecules approaches the value for fluorene for excitation by u.v. light. Excitation in the host lattice appears to be followed by an energy transfer to the pyrene molecule probably associated with re-absorption of the fluorene emission.

G.F.J.Garlick

MAGNETIC PROPERTIES OF SOLIDS

10128 MAGNETIC PROPERTIES OF THE Pd AND Pt GROUP TRANSITION METAL COMPLEXES.

H.Kamimura, S.Koide, H.Sekiyama and S.Sugano.

J. Phy. Soc. Japan, Vol. 15, No. 7, 1264-72 (July, 1960).

The magnetic susceptibilities and the g-values of the Pd and Pt group transition metal complexes are calculated by means of the intermediate coupling scheme. Crystalline field with cubic symmetry is assumed to be strong, so that the effect of $d\gamma$ orbitals is neglected. The effect of Coulomb repulsion is considered to be comparable with that of the spin—orbit interaction. The results are expressed by functions of parameters $\eta = \zeta_d/(3B + C)$ and kT/ζ_d, where B and C are Racah's parameters and ζ_d the coefficient of spin—orbit coupling of a d-electron. Comparison with available experimental data is also made.

10129 PARAMAGNETIC SUSCEPTIBILITY OF POLYCRYSTALLINE PRASEODYMIUM METAL.

S.Arajs, R V.Colvin and J.M.Peck.

J. chem. Phys. (USA), Vol. 34, No. 6, 1959-62 (June, 1961).

The susceptibility was measured between 300 and 1500°K. The measurements are in good agreement with the predictions of the Van Vleck theory of paramagnetism based on a localized f-electron model of noninteracting Pr^{3+} ions. By making a reasonable correction for the contribution of conduction electrons to the paramagnetism, a best fit to the experimental results is obtained by using a screening constant $\sigma = 34$.

10130 CORRELATION BETWEEN MAGNETIC SUSCEPTIBILITY AND HYDROGEN SOLUBILITY IN ALLOYS OF EARLY TRANSITION ELEMENTS.

D.W.Jones, N.Pessall and A.D.McQuillan.

Phil. Mag. (GB), Vol. 6, 455-9 (March, 1961).

The solubility of hydrogen in the alloys of the binary systems Ti—Nb and Ti—Mo and the heat of solution of a small quantity of hydrogen in b.c.c. alloys of these systems were measured. In addition, the magnetic susceptibility at room temperature was measured for alloys in the systems Ti—Nb, Nb—Mo and Ti—Mo. All of these measured parameters were plotted against the electron/atom ratio assuming valencies of 4, 5 and 6 for Ti, Nb and Mo respectively, and the curves all show a critical composition equivalent to about 5.6 electrons/atom. The results are interpreted on an electron band model. A.E.Kay

10131 THE SUPERPARAMAGNETIC INITIAL SUSCEPTIBILITY OF PARTICLES WITH ARBITRARY ANISOTROPY.

A.Hahn.

Z. angew. Phys. (Germany), Vol. 13, No. 3, 165-7 (March, 1961). In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). For an isotropic assembly the susceptibility is shown to be independent of the anisotropies of the individual particles.

E.P.Wohlfarth

10132 MAGNETIC CONFIGURATIONS. F.Bertaut.

C.R. Acad. Sci. (France), Vol. 252, No. 1, 76-8 (Jan. 4, 1961). In French.

A theoretical method of general applicability for studying magnetic configurations is presented. Three particular applications are considered: (1) colinear modes; (2) Bravais lattice; (3) planar lattices, (a) with equivalent sublattices, and (b) with non-equivalent sublattices. S.A.Ahern

10133 COLINEAR SPIN CONFIGURATIONS IN CORUNDUM TYPE STRUCTURES. F.Bertaut.

C.R. Acad. Sci. (France), Vol. 252, No. 2, 252-4 (Jan. 9, 1961). In French.

It is shown that colinear magnetic configurations, possible in corundum type structures (α-Fe_2O_3; Cr_2O_3) can be evaluated as solutions of a matrix equation. The stability regions are defined by inequality relations between exchange integrals. S.A.Ahern

10134 SPIN CONFIGURATIONS IN THE GENERAL CASE. F.Bertaut.

C.R. Acad. Sci. (France), Vol. 252, No. 14, 2078-80 (April 5, 1961). In French.

Continuation of previous work (see preceding abstract). Discusses the relation between group theory and matrix methods of analysis, the spin configurations in coupled atomic systems, generalized formulation for non-isotropic interactions and application of these ideas to α-Fe_2O_3. . — C.A.Hogarth

DISPERSION OF THE PERMEABILITY AND PERMITTIVITY OF ARTIFICIAL DIELECTRICS IN THE FREQUENCY RANGE 500-35000 Mc/s. See Abstr. 10074

THE ELECTRICAL RESISTIVITIES AND MAGNETIC SUSCEPTIBILITIES OF SOME STABLE AND METASTABLE URANIUM—MOLYBDENUM ALLOYS. See Abstr. 10025

EFFECT OF PARAMAGNETISM ON RADIOACTIVE γ-RAY ANGULAR CORRELATIONS. See Abstr. 9834

10135 HYPERFINE FIELD AND ATOMIC MOMENT OF IRON IN FERROMAGNETIC ALLOYS.

C.E.Johnson, M.S.Ridout, T.E.Cranshaw and P.E.Madsen.

Phys. Rev. Letters (USA), Vol. 6, No. 9, 450-1 (May 1, 1961).

The fractional variation of the magnetic field at iron nuclei in alloys with excess electron number, x, was obtained by the measurement of the Mössbauer absorption spectrum at room temperature over the whole range of Fe—Co and Fe—Ni alloys for the 14.4 keV γ-radiation of Fe^{57}. Variations in the hyperfine field, H_n, due to local inhomogeneities were small and there was no large change in s-electron density at the iron nuclei due to alloying. For both alloy systems H_n and the saturation moment show a maximum near $x = 0.3$. Even for small additions of solute it seems that large changes in H_n result, in contrast to the localized theories.

E.A.Sanderson

10136 MAGNETIC ANISOTROPY INDUCED BY COLD ROLLING IN Cu–Co ALLOY. T.Mitui.
Phys. Soc. Japan, Vol. 15, No. 5, 929 (May, 1960).

Torque measurements indicate that the uniaxial anisotropy rises as a result of the shape anisotropy of the precipitates eing affected by plastic deformation and inhomogeneous slip.

E.P.Wohlfarth

10137 INFLUENCE OF COLD WORKING AND HEAT TREATMENT ON THE ELECTRICAL AND MAGNETIC OPERTIES OF Fe–Al ALLOYS. G.Rassman and H.Wich.
angew. Phys. (Germany), Vol. 13, No. 4, 172-4 (April, 1961). German.

"Ferromagnetism Working Party", Wiesbaden, 1960 (see Abstr. 36 of 1960). The cold resistance and magnetic properties of –Al alloys containing from 9-18% by weight of Al are described. ld working shows a strong decrease in resistance and produces narked magnetic anisotropy. The restoration of the electrical d magnetic properties may be achieved by annealing at between) and 250° C.

C.A.Hogarth

10138 FIELD INDUCED ANISOTROPY IN Fe–Al AND Fe–Si SINGLE CRYSTALS. H.Gengnagel and H.Wagner.
angew. Phys. (Germany), Vol. 13, No. 4, 174-7 (April, 1961). German).

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr 36 of 1961). The effect of magnetic-field heat treatment on –Al alloys in the Fe_3Al superstructure region decreases with creasing crystallographic order. The induced anisotropy becomes measurably small which agrees with the findings of Chikazumi Ni_3Fe (Abstr. 5223 of 1956). The large value of K_u obtained by zuki on Fe_3Al could not be confirmed (Abstr. 13427 of 1959). The sults on Fe–Si agree well with those hitherto obtained on other oys.

D.S.Parasnis

10139 A METHOD OF ANALYSING THE PREVIOUS MAGNETIC HISTORY OF A FERROMAGNETIC PECIMEN USING THE PREISACH DIAGRAM. H.Seidel.
angew. Phys. (Germany), Vol. 12, No. 11, 493-501 (Nov., 1960). German.

The previous history (application of a.c. or d.c. fields) is introced formally into a portion of the Preisach diagram. A section of e distribution function is deduced from measurements on soft ckel specimens.

E.P.Wohlfarth

10140 THE INFLUENCE OF INTERNAL MAGNETIC INTERACTIONS ON THE SHAPE OF THE PREISACH UNCTIONS OF HIGH PERMEABILITY MATERIALS. H.Girke.
. angew. Phys. (Germany), Vol. 12, No. 11, 502-8 (Nov., 1960). German.

An anomalous asymmetry of the distribution function (Abstr. 76 of 1960) is interpreted as due to the action of an internal field roportional to the induction.

E.P.Wohlfarth

10141 THE THEORY OF THE ANISOTROPY OF COERCIVE FORCES IN SINGLE CRYSTAL DISKS. V.R.Abel's.
z. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 305-6 ug., 1960). In Russian.

The magnetic structure of disks of cold-rolled silicon iron is vestigated by means of powder figures. From the results an planation is suggested for the discrepancy between the theoretical d experimental variation of coercive force with orientation.

R.F.S.Hearmon

10142 MAGNETIZATION PROCESS IN SMALL PARTICLES OF CrO_2. F.J.Darnell.
appl. Phys. (USA), Vol. 32, No. 7, 1269-74 (July, 1961).

Initial magnetization curves, remanence, coercivity, reversible sceptibility, and rotational hysteresis were measured for CrO_2 the form of small particles. The measurements allow rough vision into three types of behaviour with decreasing particle size ltidomain, or bulk behaviour, for ~ 100 μ particles; few-domain haviour for ~ 1-10 μ particles; and single-domain behaviour for rticles with a length: diameter ratio ~ 5 and a diameter ≤ 0.2 μ. e smaller particles studied were acicular and showed coercivity minated by shape anisotropy.

10143 PERMANENT MAGNETIC PROPERTIES OF DEFORMED Fe-Mn-Ti ALLOYS. G.Rassman and O.Henkel.
angew. Phys. (Germany), Vol. 13, No. 4, 169-70 (April, 1961). German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 36 of 1961). By deformation of the alloys a quasi-ferrite ructure is obtained showing a fairly high coercivity.

C.A.Hogarth

10144 ON THE COERCIVE FORCE OF ZONE-MELTED IRON. A.Mager and H.Hillmann.
Z. angew. Phys. (Germany), Vol. 13, No. 4, 171-2 (April, 1961). In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). Rods of sintered carbonyl iron were purified by zone melting at zone rates of 0.3 to 10 mm per minute and subjected to appropriate heat treatment. A definite dependence of the coercivity on zone rates was observed. Repeated zone melting gave a minimum value of 16 mOe for the coercivity of pure iron.

D.S.Parasnis

10145 MAGNETIZATION OF NICKEL SINGLE CRYSTALS. L.Tterlikkis and A.W.Jenkins, Jr.
J. appl. Phys. (USA), Vol. 32, No. 7, 1293-6 (July, 1961).

A calculation of the magnetization curves of nickel single crystals is made by the method of Lawton and Steward (Abstr. 1281 of 1948) for arbitrary orientation of the crystal in the field. The anisotropy coefficients are calculated from experimental curves with the applied field in symmetry directions, and it is found that only K_1 can be determined reliably with the data used. The calculated off-axis curves agree well with experimental results. A correcting field determined from the easy-axis magnetization curve is utilized to compensate for internal strain effects. The relation between the calculated field minus the observed field and the easy-axis field suggests a possible method for measuring internal strain energy in ferromagnetic crystals.

10146 DYNAMICS OF BARKHAUSEN DISCONTINUITIES. A.M.Rodichev and V.A.Ignatchenko.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 903-8 (June, 1960). In Russian.

In a study of the character of motion of the domain boundary associated with a Barkhausen discontinuity, a solution was obtained of the equation of this motion in which all the principal forces, acting on the boundary, were taken into account. Formulae were derived which describe the relationship between the speed and duration of the process and various characteristics of a ferromagnetic.

M.H.Sloboda

10147 THE INFLUENCE OF THE PARAMETERS OF FERROMAGNETICS ON MEASUREMENT OF BARKHAUSEN EFFECT. K.M.Polivanov, A.M.Rodichev and V.A.Ignatchenko.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 778-89 (May, 1960). In Russian.

The effect of (a) eddy currents in a ferromagnetic and (b) the position of the domain of reversible magnetic moment in the interior of the specimen, on the parameters of the e.m.f., induced in a search coil by a Barkhausen discontinuity, was studied. It was shown that the duration of the intermediate process associated with the eddy currents is, for the bulk of Barkhausen discontinuities, considerably longer than the duration of the discontinuity itself. Based on the principle of reciprocity, a formula was derived for the e.m.f. induced in the search coil by the variable magnetic moment of a domain, situated in the interior of a ferromagnetic cylinder at an arbitrary distance from its axis.

M.H.Sloboda

10148 TEMPERATURE MAGNETIC HYSTERESIS OF SINGLE CRYSTALS OF SILICON IRON.
L.V.Kirenskii, D.A.Laptei, A.I.Drokin and R.P.Smolin.
Fiz. Metallov. i Metallovedenie (USSR), Vol. 9, No. 3, 337-44 (March, 1960). In Russian.

The temperature magnetic hysteresis measured along the [100], [110] and [111] directions was investigated. In each case the intensity of magnetization was measured, as the temperature was changed from 0° to over 700° C and back to 0°, the specimen being kept in a constant magnetic field. For each direction, six such cyclic changes of temperature were applied, with six different constant fields. Results are exhibited graphically, and are analysed from the point of view of domain structure. Six Bitter photographs are shown and help to formulate a theory.

N.Davy

10149 INFLUENCE OF PREPARATION AND QUENCHING ON THE MAGNETIC PROPERTIES OF PRECIPITATES IN Cu–Co ALLOYS. M.Sato and T.Mitui.
J. Phys. Soc. Japan, Vol. 15, No. 3, 537 (March, 1960).

Measurements of the variation of magnetic properties of a Cu–Co alloy during ageing are reported as a function of prior treatment.

H.Mykura

MAGNETIC PROPERTIES OF NICKEL FILMS VACUUM-DEPOSITED ON GLASS. See Abstr. 10027

10150 EXPERIMENTAL INVESTIGATIONS OF THE DISTRIBUTION LAW OF FERROMAGNETIC DOMAINS BASED ON THE CRITERION OF COERCIVITY. B.Rothenstein.
Czech. J. Phys., Vol. 10, No. 4, 299-305 (1960). In German.

Measurements of internal friction of ferromagnetic metals by means of an applied alternating magnetic field added to a fixed steady field show that the distribution of domains relates to the measured coercivity. If equal alternating and steady fields are used and the frequency of the alternating field is varied it may be observed that the walls of each domain having different coercivity exhibit induced oscillations at different speeds. C.A.Hogarth

10151 OBSERVATIONS OF CROSS-TIE DOMAIN WALLS BY THE FARADAY EFFECT. A.L.Houde.
J. appl. Phys. (USA), Vol. 32, No. 7, 1234-7 (July, 1961).

A microscopic Faraday effect apparatus is described by means of which the fine structure of the domain configurations in thin Permalloy films was observed. The direction of the magnetization in cross-tie domain walls and other domain configurations was deduced from their light, dark, or grey appearance and known polarizer angles. Faraday effect hysteresis loops are presented in support of a proposal that domain walls at 45° to the easy direction represent an intermediate demagnetized state in films having a high degree of uniaxial anisotropy.

10152 THE POLARITY OF DOMAIN WALLS IN THIN FERROMAGNETIC FILMS. L.V.Kirenskii and V.A.Buravikhin.
Dokl. Akad. Nauk SSSR, Vol. 136, No. 3, 575-6 (Jan. 21, 1961).
In Russian.

For abstract, see Abstr. 7753 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 6, No. 1, 51-3 (July, 1961)].

10153 TRANSMISSION ELECTRON MICROSCOPE OBSERVATIONS OF MAGNETIC DOMAIN WALLS.
J.T.Michalak and R.C.Glenn.
J. appl. Phys. (USA), Vol. 32, No. 7, 1261-5 (July, 1961).

Ferromagnetic domain wall images were observed in a variety of ferromagnetic materials by an electron transmission technique employing defocusing of the objective lens. Image formation and contrast effects are interpreted on the basis of charged particle motion through a magnetic field and electron microscope imaging. Observations are consistent with magnetic domain theory; domain sizes and wall geometry were confirmed by the Bitter pattern technique.

10154 ELECTRON OPTICAL INVESTIGATION OF DOMAIN BOUNDARIES IN THIN FERROMAGNETIC FILMS.
L.Reimer.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 143-7 (March, 1961).
In German.

"Ferromagnetism Working Party", Wiesbaden, 1960 (see Abstr. 7736 of 1961). The formation and movement of domain boundaries in nickel and iron films was investigated by an electron optical shadow method similar to that of Hale et al. (Abstr. 8298 of 1959). A special polepiece insert was devised for applying a magnetic field parallel to the plane of the film during observation. During reversal of magnetization the first effect in many cases was an inhomogeneous rotation of the directions of magnetization, until regions of anti-parallel magnetization were formed in some places and these then acted as nuclei for reversed magnetization.
V.E.Cosslett

10155 THICKNESS DEPENDENCE OF DOMAIN ORIENTATION IN THIN NICKEL FILMS. K.Kuwahara and M.Goto.
J. Phys. Soc. Japan, Vol. 15, No. 2, 359 (Feb., 1960).

The magnetic field H_s required to produce technical saturation was determined by observing the variation of magnetoresistance with field. An abrupt change in H_s is observed at a particular thickness due to the direction of easy magnetization changing from the plane of the film to the normal. The critical thickness calculated from Kittel's theory agrees well with experiment. D.J.Oliver

10156 DOMAIN PATTERNS ON THIN FILMS OF PERMINVAR. Y.Gomi, Y.Odani and M.Sugihara.
J. Phys. Soc. Japan, Vol. 15, No. 3, 533-4 (March, 1960).

New interesting domain patterns were observed in Perminvar films in the thickness range 300 to 2000 A deposited on to a glass substrate in the absence of a magnetic field. The patterns were observed using the Bitter technique. The structure of the various patterns observed is discussed. S.A.Ahern

10157 THE MAGNETIC DEFLECTION OF ELECTRON BEAMS IN THIN IRON FILMS.
H.Boersch, W.Raith and H.Weber.
Z. Phys. (Germany), Vol. 161, No. 1, 1-12 (1960). In German.

The deflection was observed electron-optically on iron layers of thickness 300-1000 A evaporated on a heated NaCl substrate. The influence of the shape-dependent demagnetizing field was investigated The value of the saturation magnetization deduced equals that of bulk iron. E.P.Wohlfarth

10158 FIELD INDUCED AND INCIDENCE ANGLE ANISOTROPY IN NICKEL—IRON FILMS. E.Feldtkeller.
Z. angew. Phys. (Germany), Vol. 13, No. 2, 74-6 (Feb., 1961).
In German.

The magneto-optical Faraday effect was used to examine the distribution of anisotropy in a nickel—iron film evaporated on to a substrate at room temperature in a homogeneous magnetic field. A combination of field induced and incidence angle anisotropy was observed, marked by two points in the region of which all anisotropy directions occurred. The distribution of wall coercivity was also studied and was found to be a complicated function of the angle of incidence of the evaporating beam. A.J.Manuel

10159 THE THEORY OF MAGNETIZATION REVERSALS IN THIN FILMS. W.Andrä.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 141-3 (March, 1961).
In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). Discusses the nucleation of domain walls at the edges of homogeneous film specimens which occurs in place of magnetization rotations above a critical thickness t (~2000 A for Ni). For films with a local lowering of the anisotropy, domain walls can also be nucleated in the interior of the films and possibly for films even thinner than t. E.P.Wohlfarth

10160 ON THE CURIE TEMPERATURE OF VERY THIN NICKEL FILMS. W.Hellenthal.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 147-9 (March, 1961).
In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). Below 150 A thickness the ratio of the Curie temperatures for solid nickel to those for nickel films falls with decreasing film thickness from unity to 0.4 at 20 A. Calculations based on a molecular field theory for the temperature dependence of spontaneous magnetization lead to an explanation for the effect.
C.A.Hogart

10161 THE MAGNETIC PROPERTIES OF VERY THIN IRON FILMS EVAPORATED IN VACUO AND THEIR VARIATION WITH ADMISSION OF AIR. H.Hoffmann.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 149-51 (March, 1961).
In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). The magnetization of iron films down to 30 A is the same as for bulk material and independent of film thickness so long as measurements are carried out in vacuo. Admittance of air leads to a variation of magnetization with film thickness.
C.A.Hogarth

10162 TEMPERATURE DEPENDENCE OF THE MAGNETIC PROPERTIES OF THIN PERMALLOY FILMS.
A.Segmüller.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 154-7 (March, 1961).
In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). The temperature dependence of coercivity and the uniaxial anisotropy are investigated. Irreversible changes in coercive force arise from structural variations with temperature.
C.A.Hogarth

10163 THE REMAGNETIZATION OF THIN NICKEL—IRON FILMS IN THE DIFFICULT DIRECTION. I. ELECTRON MICROSCOPIC OBSERVATIONS OF DOMAIN PRODUCTION.
E.Fuchs.
Z. angew. Phys. (Germany), Vol. 13, No. 3, 157-60 (March, 1961).
In German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 7736 of 1961). By incorporating a Helmholtz coil in the electron microscope it is possible to study magnetization in a ferromagnetic film as a function of applied magnetic field. Photographs show in detail how the break-up into many domains occurs after magnetization in the difficult direction in films with uniaxial anisotropy. The direction of domain vectors is judged from the perpendicular striations which occur as a result of fluctuations of the magnetization. R.Parker

10164 THE REMAGNETIZATION OF ANISOTROPIC NICKEL-IRON FILMS IN THE DIFFICULT DIRECTION. II. YSTERESIS AND DOMAIN BEHAVIOUR. E.Feldtkeller.

. angew. Phys. (Germany), Vol. 13, No. 3, 161-4 (March, 1961). German.

"Ferromagnetism Working Party" Wiesbaden, 1960 (see bstr. 7736 of 1961). On the assumption of noninteracting domains ne derives a linear, reversible magnetization curve for the emagnetization of thin anisotropic films. In practice one observes hysteresis loops with characteristic jumps in 500 A thick lms of 80%Ni–20%Fe alloys. An explanation of the hysteresis henomena is outlined qualitatively in terms of Néel walls magetized in the same sense and in terms of the resulting dispersion elds.

R.Parker

10165 NOTE ON THE BACK REACTION TERM IN FERROMAGNETIC RELAXATION EQUATIONS.

.Callen.

. appl. Phys. (USA), Vol. 32, No. 4, 738 (April, 1961).

Answers some criticisms (Abstr. 6258 of 1960; 2490 of 1961) hich have been made of a previous paper (Abstr. 8287 of 1959) nd explains the circumstances in which a back reaction term is nportant.

D.J.Oliver

10166 TWO-PHASE PERMALLOY FOR HIGH-SPEED SWITCHING. E.A.Nesbitt and E.M.Gyorgy.

. appl. Phys. (USA), Vol. 32, No. 7, 1305-8 (July, 1961).

The addition of gold to Permalloy had made it possible to recipitate a second phase in the alloy. As a result it is possible to ontrol the coercive force and, to some degree, the threshold for otational flux reversal, by appropriate heat treatments. On this asis a series of alloys was developed by adding 2-14% gold to ermalloy. Some of these alloys have switching times approximately ur times faster than that of the standard Permalloy composition. he switching time is defined as the reversal time at twice the oercive force. The alloy is prepared by annealing at the solution emperature of 900°C and then cooling rapidly. This is followed by old rolling tape from approximately 0.014 to 0.00013 in. thickness, hich is the thickness for switching applications. The material is hen annealed at 600°-650°C. Under these conditions, alloys ontaining 7% gold and 14% gold yield square hysteresis loops having oercive forces of at least 1.7 and 4.3 Oe, respectively. For the % gold alloy, the threshold for rotational flux reversal is 2.5 Oe.

10167 DEMAGNETIZATION OF SQUARE-LOOP FERRITES. G.Vogler.

. angew. Phys. (Germany), Vol. 13, No. 4, 185-7 (April, 1961). German.

By means of a simplified model the conditions energetically vourable for a nucleating configuration at a domain edge are stimated. In the limit these lead to the limiting field strength r irreversible domain growth. A mechanism is proposed whereby emagnetization of a few centres takes place and a chain reaction llows in which the external field merely assists.

C.A.Hogarth

10168 SOME METHODS AND RESULTS IN THE STUDY OF CUBIC FERRITES. K.Hoselitz.

. angew Phys. (Germany), Vol. 13, No. 4, 182-4 (April, 1961).

"Ferromagnetism Working Party" Wiesbaden, 1960 (see Abstr. 736 of 1961). A short review is given of a research programme to udy the magnetocrystalline anisotropy and microwave properties single crystals of cubic ferrites. The crystals were grown by one three methods: Co–Mn and Mn ferrites of varying compositions ere grown by the Verneuil technique; for magnetite, manganese errite and $Fe^{2+}Al^{3+}_{0.3}Fe^{3+}_{1.7}O_4$ (composition aimed at) the Bridgman–ockbarger technique (Abstr. 6870 of 1952) was used; and a number other compositions, in particular garnet ferrites, were grown precipitation from a flux bath (see Abstr. 8990 of 1959). Measureents were made on these crystals of magnetic anisotropy, resoance field and resonance line width, as well as saturation magnetation and other properties. Torque curves were measured on nall spherical specimens at temperatures of 1.5, 4.2, 20 and -300°K using a recording torque magnetometer described by earson (Abstr. 13828 of 1960). Resonance measurements were ade in the region of 9 kMc/s and 17 kMc/s. The results obtained re discussed briefly.

S.A.Ahern

10169 INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF THE MAGNETIZATION OF MAGNETICALLY ARD FERRITES. G.Heimke.

erromagnetism Working Party, Berlin, 1959 (see Abstr. 18171 of 960) p. 213-21. In German.

The oxide magnets with magnetoplumbite structure show an anomalous temperature dependence in that the saturation magnetization decreases linearly with increasing temperature. The lattice of barium ferrite ($BaO.6Fe_2O_3$) consists of 5 sublattices, the carriers of the magnetic moment being the Fe^{+++} ions. Besides the exchange coupling scheme suggested by Went et al. (Abstr. 5900 of 1952) with a resultant magnetic moment of 40 μ_B for the unit cell, two other schemes giving moments of 20 and 60 μ_B are considered. A discussion of the various exchange interactions indicates that if the ferric ions in the sublattice (these being characterized by an octahedral arrangement of the surrounding O-ions) are replaced by non-magnetic ions, the temperature dependence of the ferrite will be modified. This is possible if a suitable compound of the type BaM_2O_3 exists where M is a non-magnetic ion of an appropriate diameter capable of passing from the divalent state to the trivalent one. No such ion has hitherto been found but the titanium ion in $BaTiO_3$ can pass from the quadrivalent state to the trivalent state and seems to afford certain possibilities. A ferrite prepared by sintering barium titanate and iron oxide in the proportion $BaTiO_3.5Fe_2O_3$ does not show a temperature dependence significantly different from that of $BaO.6Fe_2O_3$. When 0.8% SiO_2 is added as $CaSiO_3$ to the same mixture, the temperature dependence of saturation magnetization below 0°C and that of remanence below 200°C is radically altered. The temperature coefficient of remanence is 0.04% in the range from –40° to +40°C.

D.S.Parasnis

10170 THE ANGULAR DEPENDENCE OF MAGNETIC FIELD INDUCED ANISOTROPY IN AN IRON–NICKEL FERRITE SINGLE CRYSTAL. R.Wagner.

Ann. Phys. (Germany), Vol. 7, No. 5-6, 302-11 (1961). In German.

Torque curves were obtained for a single crystal sphere of $Fe_{0.25}Ni_{0.75}Fe_2O_4$ after cooling from 300°C in a magnetic field of about 5 Oe. The magnetic field during cooling was applied at various angles to the [001] [001] and [$\bar{1}$01] directions for measurements in the (100) (110) and (111) planes respectively. The results indicate that the magnetic field induced anisotropy is always in the direction of the cube edges of the cubic spinel lattice.

A.J.Manuel

10171 PREPARATION, AND STUDY OF SOME PROPERTIES, OF MIXED YTTRIUM AND RARE EARTH GARNETS.

J.Loriers and G.Villers.

C.R. Acad. Sci. (France), Vol. 252, No. 11, 1590-2 (March 13, 1961). In French.

The properties of mixed Y and rare earth garnets of the form $5Fe_2O_3(3-x)Y_2O_3xLn_2O_3$ (Ln being either La, Pr, Nd, or Sm) are examined for values of x between 0 and 3. The maximum value of x and hence the limits of solid solution for the various garnets were determined, for Nd $x \cong 2.0$, for Pr $x \cong 1.4$, for La $x \cong 0.45$, while for Sa x could be made equal to 3. Three graphs are given showing variation of lattice constant, Curie temperature, and magnetic moment with x. Results for Ce with its possible valencies of 3 or 4 are more complex and will be published later.

A.P.C.Thiele

10172 INVESTIGATION OF THE FERRITES–YTTRIUM AND GADOLINIUM GARNETS, NEAR THE FERROMAGNETIC CURIE POINT. V.I.Chechernikov and R.F.Uchaikina.

Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 3, 457-8 (March, 1960). In Russian.

The relation between magnetic susceptibility, temperature and field strength of these garnets in the region of the ferromagnetic transformation was investigated experimentally by the Faraday–Sucksmith method. The results are represented by two graphs in which i/χ is plotted against temperature over the range 510°-630°K. The transition range of 8-10 deg K is narrow compared with that occurring in most ferromagnetics including ferrites (20°-100°). Above the Curie point, χ is practically independent of the field strength; below that point χ is markedly dependent on H. The Curie point found is 562°K for both substances. The relationship found to connect H and σ, the specific magnetization is

$$H = \alpha\sigma + \beta\sigma^3,$$

where α and β depend on temperature. Néel's hyperbolic law connecting i/χ and T is obeyed over the range 580°-1400°K.

N.Davy

10173 MAGNETOCALORIC EFFECT AND MAGNETIZATION OF THE FERRIMAGNETIC SULPHIDE OF CHROMIUM.

V.N.Novogrudskii and I.G.Fakidov.

Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 3, 332-6 (March, 1960). In Russian.

The magnetocaloric effect Δt in an ellipsoid of ferrimagnetic $CrSb_{1\cdot17}$ was measured at various temperatures by switching on a magnetic field. Then the experiment was repeated with four other values of the field. The intensity of magnetization σ was measured by the ballistic method, and the Curie point was found to be 32.6°C. The spontaneous intensity of magnetization σ_0 was calculated by extrapolating the rectilinear parts of the graphs of Δt plotted as a function of σ^2, at each temperature, to meet the axis of σ^2. It was found that

$$(\sigma/\sigma_0)^2 = \xi(1-T/\theta)$$

where θ is the Curie absolute temperature, T is the absolute temperature in an experiment and ξ is a coefficient which on the Frenkel-Heisenberg theory should equal 3.0 for all ferromagnetics. Here $0.4 < \xi < 1.6$. Results are exhibited in numerous graphs.

N.Davy

10174 PRINCIPAL MAGNETIZATIONS OF CHROMIC CHLORIDE. H.Bizette, C.Terrier and A.Adam.
C.R. Acad. Sci. (France), Vol. 252, No. 11, 1571-3 (March 13, 1961). In French.

Measurements of the magnetizations and susceptibilities parallel and perpendicular to the trigonal axis in fields up to 16 000 Oe and at temperatures from 1.7° to 77°K are reported. The results are discussed with reference to neutron diffraction studies.

A.J.Manuel

10175 THE PERPENDICULAR SUSCEPTIBILITY OF AN ANISOTROPIC ANTIFERROMAGNET. M.E.Fisher.
Physica (Netherlands), Vol. 26, No. 8, 618-22 (Aug., 1960).

Discusses the perpendicular susceptibility $\chi_\perp$ of an antiferromagnetic, where the anisotropy energy can be represented by a Hamiltonian of the type

$$-J\Sigma_{(ij)}[\sigma_i^z \sigma_j^z + \gamma(\sigma_i^x\sigma_j^x + \sigma_i^y\sigma_j^y)].$$

An exact solution of $\chi_\perp$ is possible for the highly anisotropic case, $\gamma \to 0$, and the series expansion obtained is adapted to the cases of the two dimensional honeycomb and square lattice. For the general case, $1 > \gamma > 0$ perturbation calculations show that $\chi_\perp$ at 0°K depends strongly on γ.

R.Parker

ANTIFERROMAGNETIC—FERROMAGNETIC TRANSITION IN Fe—Rh ALLOYS. See Abstr. 9145

ON THE PROBLEM OF THE EXISTENCE OF SUPERCONDUCTIVE STATE IN ANTIFERROMAGNETIC METALS. See Abstr. 9511

ON THE QUESTION OF THE EXISTENCE OF SUPERCONDUCTING ANTIFERROMAGNETICS. See Abstr. 9512

Magnetic Resonances

FERROMAGNETIC RESONANCE PROPERTIES OF CUBIC FERRITES. See Abstr. 10168

10176 QUANTUM MECHANICAL DERIVATION OF FORMULAE FOR ANTIFERROMAGNETIC RESONANCE.
Pu Fu-cho [P'u Fu-ch'o].
Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 476-83 (Feb., 1961). In Russian.

The method of employing the doubly-periodic Green's functions of temperature used in 1960 in order to obtain formulae for the resonance frequency and susceptibility tensor of ferromagnetic resonance (Abstr. 8077 of 1960; 2489 of 1961) is now applied to antiferromagnetic resonance. As before, all the results obtained hold over a wide range of temperature. The cases of simple cubic and body-centred cubic lattices are discussed. Further, the two cases in which the direction of the constant field is (a) parallel and (b) perpendicular to the axis of anisotropy are considered separately. The radio-frequency field is perpendicular to the constant field in both cases. [English translation in: Soviet Physics—Solid State (USA)].

N.Davy

10177 STUDY OF SOLIDS BY PARAMAGNETIC RESONANCE. E.E.Schneider.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 183-93 (Sept., 1960). In French.

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). The application of electron spin resonance to the study of solid solutions in ionic crystals and of electronic conduction phenomena in semiconductors and metals is briefly discussed. The formation of electron and hole centres in alkali halides is considered as a model case of radiation effects in solids. The investigation of such centres by ordinary and double resonance techniques is surveyed, including some recent results on irradiated LiF.

10178 CYCLOTRON AND PARAMAGNETIC RESONANCE IN DEFORMED CRYSTALS. G.E.Pikus and G.L.Bir.
Fiz. tverdogo Tela (USSR), Vol. 3, No. 3, 1001-4 (March, 1961). In Russian.

Suggestions are made of possible new investigations in this field. [English translation in: Soviet Physics—Solid State (USA)].

K.G.Majo

10179 FURTHER EXPERIMENTS CONCERNING AN UNUSUAL LOW-TEMPERATURE BEHAVIOUR OF SOME MAGNETIC AMMONIATE CRYSTALS.
L.Bellomonte, M.B.Palma-Vittorelli, M.U.Palma and F.Persico.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 205-12 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). In paramagnetic resonance studies of tetrammine copper sulphate single crystals, a peculiar temperature-dependence of the g-values, of line-width and of line-shape was found in the helium temperature range. In hexammine nickel iodide a temperature-dependent absorption line in low fields, together with a corresponding shift of the main absorption line, was detected, in the range from 1.3-8°K, which supports the hypothesis of an antiferromagnetic transition.

10180 PARAMAGNETIC RESONANCE OF THE Fe^{3+} ION IN KAOLINITE. E.Boesman and D.Schoemaker.
C.R. Acad. Sci. (France), Vol. 252, No. 13, 1931-3 (March 27, 1961) In French.

Sixteen specimens of different origins all gave spectra at room temperature consisting of a triplet near g = 4.2 and a singlet near g = 2. The spectra are attributed to Fe^{3+} ions in tetrahedral and octahedral sites respectively.

E.F.W.Seymou

10181 PARAMAGNETIC RESONANCE OF THE NO_2 MOLECULE IN ALKALI HALIDES DOPED WITH NITRATES. D.Schoemaker and E.Boesman.
C.R. Acad. Sci. (France), Vol. 252, No. 14, 2099-2101 (April 5, 196 In French.

Single crystals doped with $AgNO_3$, KNO_3, and $NaNO_3$ and annealed in an atmosphere of hydrogen exhibit an isotropic e.s.r. spectrum of three hyperfine structure lines which is attributed to NO_2 molecules. The hyperfine structure parameter, 13.7 gauss, is considerably smaller than that found by other workers in a variety of materials containing NO_2. However the identification is confirmed by the observation of an identical spectrum in KCl and KBr crystals grow from solutions containing NO_2^- ions and subsequently X-irradiated.

J.M.Baker

10182 NOTE CONCERNING RUBY MASER-TYPE HAMILTONIANS. P.M.Parker.
J. chem. Phys. (USA), Vol. 34, No. 4, 1459-60 (April, 1961).

Gives simple closed-form relationships between the energy eigenvalues of the $S = \frac{3}{2}$ spin Hamiltonian and the physical constants appearing in the Hamiltonian.

P.M.Parker

10183 SPIN AND CHARGE EXCHANGE IN ANIONS OF BIPHENYLYL ETHER.
D.H.Eargle, Jr, and S.I.Weissman.
J. chem. Phys. (USA), Vol. 34, No. 5, 1840 (May, 1961).

The electron spin resonance of the uninegative ion exhibits 179 hyperfine components, from which it is deduced that the unpaired spin migrates rapidly between the biphenyl groups, in contrast with the slow migration previously reported in a similar compound. The dinegative ion is diamagnetic.

E.F.W.Seymour

10184 ELECTRON NUCLEAR DOUBLE RESONANCE IN IRRADIATED ORGANIC CRYSTALS.
T.Cole, C.Heller and J.Lambe
J. chem. Phys. (USA), Vol. 34, No. 4, 1447-8 (April, 1961).

Endor was used to observe the hyperfine structure, due to the protons in CH_2 and CH, of the radical $HOOCCHCH_2COOH$ produced by irradiating single crystals of succinic acid. In addition to this hyperfine structure there is a strong line with several satellites which is due to depolarization by the second frequency field of protons distant from the paramagnetic centre which have been polarized dynamically by the microwave power.

J.M.Baker

10185 DYNAMIC POLARIZATION OF NUCLEI BY ELECTRON—NUCLEAR DIPOLAR COUPLING IN CRYSTALS. O.S.Leifson and C.D.Jeffries.
Phys. Rev. (USA), Vol. 122, No. 6, 1781-95 (June 15, 1961).

A detailed investigation is made of the dynamic polarization of

protons in $(Ce,La)_2Mg_3(NO_3)_{12}.24H_2O$ which occurs when one
urates the "forbidden" microwave transitions that simultaneously
a proton spin and a Ce^{3+} electron spin. The rate equations for
electron and nuclear polarization are solved for (a) a simple
al model, (b) a model for the case where the forbidden lines
not resolved, and (c) a model taking into account nuclear-spin
perature diffusion. An apparatus for simultaneous observation
roton magnetic resonance and Ce^{3+} paramagnetic resonance at liquid
ium temperatures is described. The Ce^{3+} spin—lattice relaxation
e T_1 is directly measured by a transient method, and it is found that
$\propto T^{-14 \pm 2}$ for temperatures in the range $1.9^\circ K < T < 2.7^\circ K$. In
same crystals, the proton relaxation time T_{1n} is also measured
a transient method and found to be $T_{1n} \propto T^{-7}$ and dependent on
concentration of Ce^{3+} ions. The relative magnitudes of T_{1n}
T_{1e} are best explained by a model intermediate between (a) and
At $T \cong 1.5^\circ K$ and a microwave frequency $\nu_e \cong 9.3$ kMc/s, the
ton polarization is observed for a number of different concentra-
ns of Ce^{3+}. The magnitude of the polarization, its dependence on
gnetic field and microwave power, and the transient behaviour
studied and qualitatively explained. In a crystal containing 1%
, the proton polarization is observed to become greater than the
rmal equilibrium value by the factor 150, which is about one-
rter of the theoretical ideal. At higher microwave frequencies
$\cong$ 50 kMc/s) it should be possible to obtain in this crystal
ficient proton polarization ($\sim$ 25%) to be useful for dynamic
clear cooling experiments and nuclear targets.

10186 STEADY-STATE NUCLEAR POLARIZATIONS VIA ELECTRONIC TRANSITIONS. R.H.Webb.
ner. J. Phys., Vol. 29, No. 7 428-44 (July, 1961).
Nuclear polarization schemes are surveyed. Special attention
given to those involving saturation of either the direct electronic
ansitions (Overhauser and "Underhauser" effects) or the weakly
rbidden electron—nucleon "cross" transitions (Jeffries and Solid
ects). Rate equations are used to find the power dependence of
ese effects. The physical systems allowing each of these effects
e considered in terms of the various types of electron—nuclear
upling. Experimental work and bibliography to date are also
rveyed.

SPIN INVERSION OPERATOR IN NUCLEAR MAGNETIC
ESONANCE. See Abstr. 9954

10187 NUCLEAR MAGNETIC RESONANCE SPECTRA OF CRYSTALS ROTATED MACROSCOPICALLY: FINE
RUCTURE OF THE SPECTRUM OF PHOSPHORUS PENTA-
LORIDE. E.R.Andrew, A.Bradbury, R.G.Eades and G.J.Jenks.
ch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 371-3 (Sept., 1960).
9th Colloque Ampere Paper (see Abstr. 4734 of 1961). It is
nted out that the dipolar broadening of the nuclear magnetic
sonance spectrum of a solid may effectively be removed by rotat-
the sample at a high speed about an axis inclined with an angle
44' to the direction of the field. Using this technique the doublet
e structure of the P^{31} spectrum of solid phosphorus pentachloride
s recorded. The two lines are ascribed to the different chemical
fts in the $(PCl_4)^+$ and $(PCl_6)^-$ ions of which the solid is composed.
e two shifts relative to aqueous phosphoric acid are found to be
31 and –96 p.p.m.

10188 STOCHASTIC THEORY OF NUCLEAR MAGNETIC RESONANCE IN ROTATING SOLIDS. S.Clough.
ch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 374-8
pt., 1960).
9th Colloque Ampere Paper (see Abstr. 4734 of 1960). Dipolar
adening is described by a random function characterized by two
ameters ω_1 and ω_2 which determine the widths of its Gaussian
bability distribution and its Gaussian frequency spectrum. With
model, a general method for obtaining the spectrum of a rotating
nple is given. When the axis of rotation is inclined at 54 deg. to
magnetic field, an approximate criterion for the spectrum to
ibit structure is

$$\exp -(3\pi^2\omega_1^2\omega_2^2/4\omega_r^4) \sim \omega_r/2\pi\omega_1$$

ere ω_r is the rotational angular frequency. At high rotation fre-
ncies the central line has the width

$$(2\pi)^{1\ 2}(2\omega_1^2/3\omega_2)\exp -(\omega_r^2/2\omega_2^2).$$

10189 INFLUENCE OF FOREIGN MAGNETIC NUCLEI ON N.M.R. A.Miyake and R.Chûjô.
hys. Soc. Japan, Vol. 15, No. 1, 198 (Jan., 1960).
The general theory of Kubo and Tomita (Abstr. 2881 of 1955) is extended to include contributions to the second moment and relaxation time due to non-resonating nuclei, including the case when extreme motional narrowing occurs. E.F.W.Seymour

10190 DIFFUSION NARROWING OF NUCLEAR MAGNETIC RESONANCE IN ALUMINIUM AND COPPER.
C.P.Flynn and E.F.W.Seymour.
Proc. Phys. Soc. (GB), Vol. 77, Pt 4, 922-30 (April, 1961).

An apparatus was developed by means of which nuclear resonance signals were observed at temperatures up to 1300°K. The variation of the line shape and width of the Cu^{63} resonance at high temperatures is found to follow quantitatively the predictions of Kubo and Tomita (1954) for motional narrowing. In conjunction with the theoretical value of the frequency factor D_0(0.28 $cm^2 sec^{-1}$) in the expression $D = D_0 \exp(-E/RT)$ for the coefficient of self-diffusion, the results yield a value 48.1 ± 0.9 kcal mol^{-1} for the activation energy for self-diffusion in copper, in agreement with the results of the most recent radio-tracer measurements. A similar change in shape and width of the Al^{27} resonance cannot be used to determine the activation energy in aluminium because of the presence of a line-broadening mechanism of uncertain origin. The data are not inconsistent, however, with the theory and the known activation energy of about 31 kcal mol^{-1}.

10191 CHEMICAL SHIFTS OF THE NUCLEAR MAGNETIC RESONANCE SIGNALS OF FLUORINE IN IONIC CRYSTALS. Van I-tsyu [Wang I-ch'iu].
Dokl. Akad. Nauk SSSR, Vol. 136, No. 2, 317-19 (Jan. 11, 1961).
In Russian.

For abstract, see Abstr. 7798 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 6, No. 1, 39-40 (July, 1961)].

10192 SIGN OF KNIGHT SHIFT IN SAMARIUM INTERMETALLIC COMPOUNDS.
J.A.White and J.H. van Vleck.
Phys. Rev. Letters (USA), Vol. 6, No. 8, 412-13 (April 15, 1961).

The sign of the rare-earth contribution to the Knight shift in $SmAl_2$ reverses in going from 77°K to room temperature. This anomaly can be theoretically explained if the second-order Zeeman effect is included. Details of the argument are given. D.J.Oliver

10193 NUCLEAR MAGNETIC RELAXATION IN VANADIUM. J.Butterworth.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 416-21 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). Measurements of the nuclear magnetic spin—spin and spin—lattice relaxation in the transition metal vanadium were made at temperatures of 20.4°, 77.3° and 292°K. No evidence of the presence of localized unpaired electrons in vanadium was found. By comparison of the results with measured values of other physical properties of vanadium, it is deduced that there is such thorough admixture of s-states and d-states at the Fermi surface in vanadium that the spin susceptibility of the s-slectrons is enhanced, by exchange interaction, to the same high degree as that of the d-electrons, namely, about 2.5 times. It is also deduced that the proportion of all the states at Fermi surface having s-character at roughly 0.17.

10194 NUCLEAR MAGNETIC RESONANCE IN VANADIUM ALLOYS. L.E.Drain.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 425-32 (Sept., 1960).

9th Colloque Ampere Paper (See Abstr. 4734 of 1961). Measurements were made of the shift, linewidth and intensity of the V^{51} resonance in dilute alloys of vanadium with chromium, manganese, iron, cobalt and nickel. The absence of an appreciable increase in linewidth or decrease in intensity in the alloys suggests that there are no localized moments on the solute atoms. Quadrupole interactions are also small, probably due to both a small electric quadrupole moment of the V^{51} nucleus and effective screening of excess charges in the alloys by conduction electrons. The Co^{59} nuclear resonance was observed in two cobalt alloys. The weak intensity and width of this resonance cannot be satisfactorily explained.

10195 TEMPERATURE DEPENDENCE OF T_1 OF Cl^{35} IN PARADICHLOROBENZENE. A.Hirai.
J. Phys. Soc. Japan, Vol. 15, No. 1, 201-2 (Jan., 1960).

T_1 varies from 560 msec at 77°K to 19 msec at 300°K. The temperature dependence agrees qualitatively with the theory of quadrupolar relaxation of Bayer. E.F.W.Seymour

10196 STUDY OF THE DYNAMIC POLARIZATION OF PROTONS IN POWDERED DIPHENYL PICRYL HYDRAZYL BY SATURATION OF THE ELECTRONIC RESONANCE IN WEAK FIELDS. You-Hing Tchao.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1765-7 (March 20, 1961). In French.

The Overhauser effect on protons in DPPH was studied in a magnetic field of 19.3 Oe. The electronic transition frequency is 54 Mc/s, and the nuclear transition frequency 82 kc/s. Measurements were made in this field region to exclude: (a) Parasitic phenomena (multiple quanta effects) which have been observed in strong fields; (b) The superposition of electronic and nuclear resonance lines, which is inevitable when the d.c. magnetic field is very weak. The most important result comes from comparing the maximum intensity of the nuclear transition signal with that of an electronic transition at the same frequency, 82 kc/s, (the electronic transition at this frequency occurring in zero applied magnetic field). It is shown that nuclear relaxation involving electron transition is important only when $(T_1)_0 \gg T_1$ (T_1 is the relaxation time via electronic transitions and $(T_1)_0$ is that characteristic of all other relaxation processes). S.A.Ahern

10197 PROTON MAGNETIC RESONANCE AT LOW TEMPERATURES OF MOLECULAR SOLIDS CONTAINING CH_3 GROUPS. E.R.Andrew, R.G.Eades, Z.M.El Saffar and J.P.Llewellyn.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 379-82 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). The proton magnetic resonance spectra and spin—lattice relaxation times were measured between 4°K and their melting points for the five solid hydrocarbons 2, 2- and 2, 3-dimethylbutane, 1,2,3-, 1,2,4- and 1,3,5-trimethylbenzene. In all five compounds methyl group orientation causes spectral narrowing, and in the case of the trimehtylbenzenes this narrowing persists at the lowest temperature of measurement. Quantum-mechanical tunnelling appears to contribute appreciably to spin—lattice relaxation. Additional forms of momecular reorientation are also reported at higher temperatures in the case of the dimethylbutanes and 1,2,3-trimethylbenzene.

10198 NUCLEAR QUADRUPOLE RESONANCE OF NITROGEN IN CYANURYL CHLORIDE. S.Kojima and M.Minematsu.
J. Phys. Soc. Japan, Vol. 15, No. 2, 355 (Feb., 1960).

The quadrupole resonance of N^{14} in solid cyanuryl chloride was studied using a Pound—Watkins type recording spectrometer with Zeeman modulation. The measured frequencies of lines give a quadrupole coupling constant of 4.083 Mc/s, and an asymmetry parameter of 1.7%. S.A.Ahern

10199 NUCLEAR MAGNETIC RESONANCE AND ITS APPLICATION TO THE TESTING OF MATERIALS. L.E.Drain.
Progress in non-destructive testing. Vol. 1 (see Abstr. 9238 of 1961) p. 227-63.

In this review paper the principles of nuclear magnetic resonance and the methods used for its detection are explained, and a number of applications to non-destructive testing are described. Applications considered include the detection of isotopes; resonance line widths and the structure of materials; the effect of molecular motion, n.m.r. in liquids, and molecular rotation and self-diffusion in solids; high-resolution n.m.r., its chemical applications and the analysis of mixtures; n.m.r. in metals and the electronic structure of metals and alloys; and nuclear quadrupole effects and defects and impurities in solids. 46 references are given. J.B.Birks

MECHANICAL PROPERTIES OF SOLIDS

10200 MICRO-TENSILE TESTING MACHINE. D.M.Marsh.
J. sci. Instrum. (GB), Vol. 38, No. 6, 229-34 (June, 1961).

Describes a tensile testing machine for microscopic specimens. It can apply loads in the range from 1 mgf to 400 gf to specimens having cross-sectional areas down to 10^{-7} mm². Specimen extensions from a few angstrom units to 15 mm can be measured and, at constant temperature, random errors in the extension measurement system are less than 5 A (5×10^{-7}mm). The machine employs a torsion balance to apply the loads and a mirror-autocollimating telescope system to detect the extensions. Since it depends wholly on mechanical and optical principles it is practically drift-free at constant temperature. It is adaptable for tests in special atmospheres, for autographic recording and for tensile testing of thin films.

10201 TENSILE TESTING MACHINE FOR WHISKERS. H.B.M.Wolters and F.W.Schapink.
J. sci. Instrum. (GB), Vol. 38, No. 6, 250-2 (June, 1961).

A screw-driven micro-tensile tester for whiskers is described. A synchronous motor moves one of the grips at a constant velocity, whereas the second grip is connected to a load cell in which a differential transformer is employed.

10202 TEMPERATURE DEPENDENCE OF ELASTIC CONSTANTS OF SOME CERMET SPECIMENS.
S.Spinner.
J. Res. Nat. Bur. Stand. (USA), Vol. 65C, No. 2, 89-96 (April-June, 1961).

The temperature dependence of both Young's and shear modulus of four types of cermet specimens, known as "nickel-bonded titanium carbide," as well as Ni and TiC were determined by a dynamic resonance method. The Young's modulus temperature curves of the cermets are characterized by a linear decrease from room temperature until about 700° to 1000°C. In this upper temperature region, an inflection in the relation develops, accompanied by an increase in internal friction. Both these effects are attributed to viscous grain boundary slip. For shear modulus, only the linear portion of the modulus temperature relation was obtained. In this linear region, the relative decrease in shear modulus for the cermet specimens is greater than the relative decrease in Young's modulus for the same type of specimen. This means that Poisson's ratio rises with temperature for the cermets.

10203 ELASTIC CONSTANTS OF IRON FROM 4.2 TO 300°K. J.A.Rayne and B.S.Chandrasekhar.
Phys. Rev. (USA), Vol. 122, No. 6, 1714-16 (June 15, 1961).

The zero-field elastic constants were measured from 4.2° to 300°K using the ultrasonic pulse technique. Extrapolation of the data to absolute zero gives $c_{11} = 2.431 \pm 0.008$, and $c_{12} = 1.381 \pm 0.004$, and $c_{44} = 1.219 \pm 0.004$, all expressed in units of 10^{12} dyne cm^{-2}. The corresponding limiting value of the Debye temperature is $\theta_0 = (477 \pm 2)^\circ K$. Using this figure, the low-temperature heat capacity data for iron were reanalysed assuming the presence of a spin-wave contribution to the specific heat, i.e., the heat capacity is assumed to follow the relation $C = \gamma T + \beta T^3 + \alpha T^{3/2}$. A least squares fit of $(C - \beta T^3)/T$ versus $T^{1/2}$ gives $\gamma = (11.7 \pm 0.1) \times 10^{-4}$ cal $mole^{-1}$ deg^{-2}, $\alpha = (2 \pm 1) \times 10^{-5}$ cal $mole^{-1}$ $deg^{-5/2}$. There is agreement, within experimental error, between the latter figure and the theoretical estimate of $\alpha = 0.8 \times 10^{-5}$ cal $mole^{-1}$ $deg^{-5/2}$ obtained from the low-temperature magnetization data of Fallot. From the room temperature elastic constants, the compressibility of iron is found to be $K = (5.95 \pm 0.02) \times 10^{-13}$ cm^2 $dyne^{-1}$, which agrees exactly with the static value obtained by Bridgman.

10204 EXPONENTIAL TEMPERATURE DEPENDENCE OF YOUNG'S MODULUS FOR SEVERAL OXIDES.
J.B.Wachtman; Jr,W.E.Teffet, D.G.Lam, Jr and C.S.Apstein.
Phys. Rev. (USA), Vol. 122, No. 6, 1754-9 (June 15, 1961).

Young's modulus was measured over the temperature range 77°-850°K by an accurate resonance technique. Data are presented for single crystals of aluminium oxide with various orientations of the crystallographic axes and for polycrystalline aluminium oxide, thorium oxide, and magnesium oxide. The results show that the range of validity of a T^4 temperature dependence predicted by theory must be quite small. The temperature dependence is very well described over the whole temperature range by $T \exp(-T_0/T)$, where T_0 is an empirical parameter.

10205 INFLUENCE OF HYDROSTATIC PRESSURE ON THE ELASTIC PROPERTIES OF CERIUM.
F.F.Voronov, L.F.Vereshchagin and V.A.Goncharova.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 5, 1104-7 (Dec. 11, 1960). In Russian.

For abstract, see Abstr. 3957 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1280-3 (May-June, 1961)].

10206 THE APPLICATIONS OF DAMPING CAPACITY FOR INVESTIGATING THE STRUCTURE OF SOLIDS.*
R.W.B.Stephens.
Progress in non-destructive testing. Vol. 1 (see Abstr. 9238 of 1961) p. 165-98.

The rate of loss of vibrational energy of a solid is a measure of its damping capacity, or internal friction. Recent applications of his to the investigation of the structure of solids are reviewed. The rticle first discusses methods of measuring damping capacity, nelasticity, the effect of experimental conditions, and the causes f damping. Phenomena which can be studied by these methods nclude annealing, plasticity, phase transformations, fatigue, effects f irradiation, solid–liquid transitions and crystallinity, diffusion ffects, and effects at very low temperatures. The applications of amping capacity measurements to semiconductors, ferroelectrics nd ferromagnetics, ferrites, ionic crystals, and glass-like materials re considered. 37 references and a bibliography of 19 books or eviews are given. J.B.Birks

10207 ON THE NATURE OF THE INTERNAL FRICTION PEAK IN HEAT TREATED STEEL.
Yu.V.Piguzov, M.A.Krishtal and S.A.Golovin.
Fiz. Metallov i Metallovedenie, (USSR), Vol. 10, No. 2, 285-90 (Aug., 1960). In Russian.

The effect of quenching in liquid N, quenching from sub-critical emperatures, and cold deformation on the magnitude of the internal riction peak, observed in steel at 200°C, was studied. The results, correlated with other experimental evidence, indicated that the existence of an internal friction peak in a hardened and tempered steel is associated with several relaxation processes such as diffusion of the C atoms in the residual austenite and movement of he C atoms in the regions of dislocations, formed as a result of he martensitic transformation or caused by thermal stresses.
M.H.Sloboda

10208 THE EFFECT OF ELASTIC VIBRATIONS ON THE INTERNAL FRICTION IN AN ALLOY OF ALUMINIUM AND 2% MAGNESIUM AT LOW TEMPERATURES.
V.P.Ketova and V.A.Pavlov.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 3, 445-52 (Sept., 1960). In Russian.

The effect of low-amplitude elastic vibrations on the temperature dependence of the internal friction at 1 500 c/s was studied between 200° and 300°K. An internal friction peak was found at 250°K; the magnitude of this peak rose with increase in the total number of executed vibrations. The peak is probably due to motion of groups of vibration-produced vacancies. A.Tybulewicz

10209 THE EFFECT OF TEMPERATURE ON THE COMPRESSION STRESS–STRAIN CURVES FOR METALS. N.N.Davidenkov and T.N.Chuchman.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 741-50 (May, 1960). In Russian.

The stress–strain curves were constructed for polycrystalline pecimens of metals with b.c.c. (Ta, Fe, Mo) and f.c.c. (Cu, Al, Ni) rystal lattice, tested in compression at −196° and 20°C. In ddition, tests were conducted during which the temperature aried in either direction between the above limits. The main ifference between the two groups of metals studied was in that the ield point of metals with the b.c.c. lattice was markedly affected y the test temperature. In addition, when the temperature was hanged during the test, the stress–strain curve for a metal of this roup assumed almost immediately the shape characteristic for he new temperature, whereas a change in the test temperature in he case of metals with the f.c.c. lattice resulted only in a slight hift of the stress–strain curve towards the position appropriate or the new temperature. Some of the effects observed were xplained in terms of the hypothesis due to Bechtold [Acta metallurgica (Internat.), Vol. 3, No. 3, 249 (1955)] according to which he effect of temperature on the stress–strain curve for metals with he b.c.c. lattice is associated with oriented re-distribution of the mpurity atoms in a field of forces, and with the resultant change f the lattice from b.c.c. to tetragonal. M.H.Sloboda

10210 DYNAMICAL EQUATION FOR A COMPRESSED PLASTIC MEDIUM. M.I.Éstrin.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 1, 36-9 (Nov. 1, 1960). n Russian.

For abstract, see Abstr. 3972 of 1961. [English translation in: oviet Physics–Doklady (USA), Vol. 5, No. 6, 1349-52 (May-June, 961)].

10211 THE SYSTEMATIC CHARACTER OF DEVIATIONS FROM PLASTICITY LAWS. N.M.Mitrokhin and Yu.I.Yagn.
okl. Akad. Nauk SSSR, Vol. 135, No. 4, 796-9 (Dec. 1, 1960). n Russian.

For abstract, see Abstr. 5082 of 1961. [English translation in: oviet Physics–Doklady (USA), Vol. 5, No. 6, 1361-3 (May-June, 961)].

10212 SLOW DEFORMATION OF SINGLE CRYSTALS OF AN IRON–NICKEL SOLID SOLUTION AT ELEVATED TEMPERATURES. V.M.Rozenberg.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 922-6 (June, 1960). In Russian.

Creep curves were constructed for two test pieces cut from a single crystal of a Fe-base alloy, containing 30% Ni, 0.4% Ti, and 0.15% Mn, one of which had been annealed at 1300°C, the other having undergone the $\gamma \rightarrow \alpha \rightarrow \gamma$ transformation as a result of quenching from 1300°C in liquid N, followed by 6 hr treatment at 700°C. The results of tests (conducted in vacuo at 750°C, under a stress of 2.5 kg/mm^2), showed that the rate of deformation in creep was much slower in the case of the annealed specimen. In addition, the number of the slip lines on the specimen surface was much lower, and the height of steps caused by slip much greater, than in the other half of the crystal. It was concluded that the difference in the behaviour of the two specimens did not reflect a basic difference in the mechanism of the deformation, since it was postulated that the more intensive slip in the crystal that had undergone the $\gamma \rightarrow \alpha \rightarrow \gamma$ transformation is attributable to a higher concentration of the crystal lattice defects. M.H.Sloboda

10213 DISTRIBUTION OF NON-HOMOGENEITIES OF PLASTIC DEFORMATION. IV. ORIENTED WORK-HARDENING AND ITS DEPENDENCE ON THE DEFORMATION TEMPERATURE. F.P.Rybalko, A.F.Nesterov and B.F.Rybalko.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 927-31 (June, 1960). In Russian.

The effect of the deformation temperature and the frequency and amplitude of the loading cycles on oriented work hardening of polycrystalline Cu tubes, subjected to cyclic loading in torsion, was studied. On increasing the amplitude of strain (up to 0.1 G), the ultimate magnitude of the residual deformation and the average intensity of the oriented work hardening increased, the latter effect being most pronounced in the initial stages of the experiments. The maximum possible increase in the residual deformation, attainable in one cycle by increasing the load amplitude, was 20%; further increase in the load amplitude brought about a reduction of this value. The intensity of oriented work hardening decreased with increasing frequency of the loading cycles. The magnitude of the residual deformation was unaffected by temperature variation, but the average intensity of oriented work hardening increased slightly with rising temperature. The maximum possible intensity of oriented work hardening increased rapidly with rising temperature below 200°C, and decreased above this temperature.
M.H.Sloboda

10214 INFLUENCE OF MARTENSITIC DEFORMATION ON THE COLD BRITTLENESS OF AUSTENITIC STEELS AND THEIR HARDENING ON PLASTIC DEFORMATION.
M.M.Belenkova, I.I.Kodlubik, K.A.Malyshev, M.N.Mikheev, V.D.Sadovskii and P.A.Ustyugov.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 1, 122-30 (July, 1960). In Russian.

Toughness, magnetic susceptibility and metallographic investigations show that cold brittleness in certain austenitic steels is caused by the formation of martensitic deformation in shock testing at low temperatures. The favourable effect of alloying with Cr and Ni in reducing or eliminating the cold brittleness is due to the increase in stability of the austenitic transformation as compared with the martensitic under plastic deformation. The formation of martensitic deformation is the cause of increased hardening on cold plastic deformation as compared with deformation at 200°-300°C. In stable austenitic steels alloyed with Cr and Ni, cold- and semi-hot working produce practically identical changes in hardening. R.F.S.Hearmon

10215 THE NATURE OF THE SUDDEN DROP IN THE PLASTICITY OF SOLID SOLUTIONS.
A.A.Presnyakov and V.V.Chervyakova.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 291-3 (Aug., 1960). In Russian.

Commenting on the presence of sharp minima on the reduction of area versus temperature curves, constructed for the 64/36 and 75/25 brasses with and without Sn addition which had already been established, it is postulated that this is a side effect of diffusion processes which take place during deformation at elevated temperature and lead to the formation of additional lattice defects and distortions. This hypothesis is supported by the anomalous character of the temperature dependence of the strength of these alloys at temperatures (~400°C) at which they display minimum plasticity.
M.H.Sloboda

10216 **DEFORMATION AGEING OF NICKEL AND THE CONSEQUENT ANOMALIES IN THE TEMPERATURE AND TIME DEPENDENCES OF ITS STRENGTH.**
V.F.Sukhovarov and R.P.Kharlova.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 6, 938-41 (Dec., 1960). In Russian.

The dependence of compressive yield stress of nickel containing small amounts of Co, Fe, Cu, Si and other elements, was studied as a function of temperature and the rate of deformation at 20°-350°C. Between 30° and 300°C deformation ageing was observed which produced an anomalously strong dependence of yield stress on temperature and rate of deformation. The deformation ageing is ascribed to formation and destruction of Cottrell atmospheres consisting mainly of carbon atoms. Cottrell's theory is used to explain the results. A.Tybulewicz

10217 **ROLE OF PLASTIC BENDING PLANE IN TENSILE DEFORMATION OF METALLIC SINGLE CRYSTALS AT ROOM TEMPERATURE.** S.Kitazima.
Mem. Fac. Engng Kyushu Univ. (Japan), Vol. 20, No. 2, 105-96 (Feb., 1961).

The α-dependencies of stress-strain curves, of width, and of interval of deformation band and striae were examined experimentally for rectangular aluminium crystals, as were the effects of thickness and localization of stress-strain curves. The orientation-dependency and axial twisting were studied for round crystals. It is concluded that the orientation-, α-, thickness- and diameter-dependency of the stress-strain curve deformation markings and the induction of latent slip are all derived from the problem of the formation of plastic bending planes.

THE INFLUENCE OF THE MECHANICAL PROPERTIES OF A SOLID ON THE RATE OF ULTRASONIC MACHINING.
See Abstr. 9241

10218 **CREEP OF METALS UNDER SIMPLE SHEAR.** E.N.da C.Andrade and K.H.Jolliffe.
Nature (GB), Vol. 190, 431-2 (April 29, 1961).

From measurements made mainly on lead, a $t^{1/3}$ law is found to hold at higher strains; for strains below about 0.03 the law is $t^{1/2}$, and for still lower strains the law may be $t^{2/3}$. H.Mykura

10219 **ON THE STRUCTURE OF SLIP PATTERNS IN METALS.** V.G.Rakin and N.N.Buinov.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 1, 156-8 (July, 1960). In Russian.

Single Al crystals and polycrystalline specimens of the 1.2% Si–Al and 1.4% Mg_2Si–Al alloys were deformed plastically in tension, and the width of the slip bands and the distance between them were measured. The presence of two maxima on the distribution curves of both these characteristics (postulated to be common for all crystalline bodies) is discussed in terms of the dislocation theory of deformation. M.H.Sloboda

10220 **THE EFFECT OF THE DIRECTION OF SLIDING ON THE [FRICTION-INDUCED] WORK HARDENING OF THE SURFACE LAYERS.** V.D.Evdokimov.
Dokl. Akad. Nauk SSSR, Vol. 136, No. 1, 74-6 (Jan., 1961). In Russian.

For abstract, see Abstr. 6465 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 6, No. 1, 59-61 (July, 1961)].

10221 **EXPERIMENTAL INVESTIGATION OF LIMITING CARRYING CAPACITY OF NICKEL TUBES FOR DIFFERENT LOAD APPLICATIONS: TENSILE STRESSES, SHEAR MOMENTS AND INTERNAL PRESSURES.**
N.Ya.Mikhailov and Yu.I.Yagn.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 3, 545-8 (Nov. 21, 1960). In Russian.

For abstract, see Abstr. 6467 of 1961. [English translation in: Soviet Physics–Doklady (USA), Vol. 5, No. 6, 1353-6 (May-June, 1961)].

10222 **LONG TERM STRENGTH AND STATIONARY CREEP OF POLYCRYSTALLINE MATERIALS.** A.N.Orlov.
Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 500-4 (Feb., 1961). In Russian.

A model based on the formation and diffusionless growth of microcracks is proposed for determining the time to rupture and the steady creep velocity. [English translation in: Soviet Physics—Solid State (USA)]. R.F.S.Hearmon

10223 **MECHANISM OF WEAR IN POLYMERS AND A SIMILARITY CRITERION.** S.B.Ratner.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 2, 294-7 (Nov. 11, 1960). In Russian.

For abstract, see Abstr. 4002 of 1961. [English translation in: Soviet Physics–Doklady (USA), Vol. 5, No. 6, 1326-9 (May-June, 1961)].

10224 **ON THE MECHANISM OF FRICTION BETWEEN METAL SURFACES.** T.Tsukizoe.
Mem. Fac. Engng Osaka City Univ. (Japan), Vol. 2, 52-7 (Dec., 1960

An approximate theory for the static friction between rough surfaces is developed. Measurements of static coefficient of friction, electrical resistance and micro-displacement prior to sliding are reported for pairs of mild steel surfaces, and results compared with theory. H.Mykura

10225 **NOTE ON THE STIFFENING OF GYPSUM PLASTER.** K.Werner.
Arch. Sci. (Switzerland), Vol. 13, No. Fasc. Spec., 390-1 (Sept., 1960).

9th Colloque Ampere Paper (see Abstr. 4734 of 1961). N.M.R. studies were made using a dried semihydrate sample to which a single drop of water was added. The stiffening process was immediately observed. It was concluded that crystallization begins instantly after adding water and finishes almost completely after an hour. The existence of a gelatinous state is discounted.

STRUCTURE OF SOLIDS

10226 **POLYMORPHIC TRANSFORMATION OF CERIUM UNDER PRESSURE.**
L.D.Livshits, Yu.S.Genshaft and Yu.N.Ryabinin.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 726-32 (May, 1960). In Russian.

The pressure, p, and temperature T, of the $\alpha \rightleftharpoons \gamma$ transformation in Ce were determined from sudden changes in the volume, V, and electrical resistance of specimens with various impurity contents. The temperature-dependence of the transformation pressure was linear in the investigated range of $p \leq 20\,000$ kg/cm² and at $75°C < T < 212°C$. The slope of the equilibrium T/p curves was the same for all specimens and equal to 0.022°C cm²/kg. The transformation pressure depended on the impurity content in Ce. The $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transformation, brought about by increasing and decreasing p, were reflected in the presence of a hysteresis loop on the p/V curve. With increasing T, the width of the loop (measured in units of p) and the magnitude of the change in V decreased. It is inferred therefrom that the equilibrium diagram of the $\alpha \rightleftharpoons \gamma$ transformation, plotted in the T/p coordinates, is characterized by the presence of a point at which the transformation takes place without any change in V. M.H.Sloboda

10227 **AN INVESTIGATION OF RECRYSTALLIZATION IN TITANIUM.**
V.D.Sadovskii, G.N.Bogacheva, LV.Smirnov, I.P.Sorokin and N.A.Kompaneitsev.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 3, 397-403 (Sept., 1960). In Russian.

Reports a study of a phase transition at 882°C from a low-temperature α-modification with hexagonal close-packed structure to a β-modification with a body-centred cubic lattice. Heat-treatment methods of reduction of grain size in titanium are discussed. A.Tybulewicz

10228 **TRANSITIONS BETWEEN DIFFERENT FORMS OF ICE.** R.H.Beaumont, H.Chihara and J.A.Morrison.
J. chem. Phys. (USA), Vol. 34, No. 4, 1456-7 (April, 1961).

Using X-ray diffraction and simple thermal analysis with experimental arrangements similar to those of de Nordwall and Staveley [Trans. Faraday Soc. (GB), Vol. 52, 1061 (1959)], it is found that vitreous ice transforms clearly to cubic ice over the range 140°-156°K with an energy release of ~12 cal/g, and that cubic ice changes into the hexagonal form over a wide range from ~200°K, with apparently no release or absorption of energy. The temperature of deposition is the important parameter, and ice formation is independent of the structure or condition of the substrate. It is suggested that greater heat leak in the system employed by Dowell and Rinfret (Abstr. 6518 of 1961) may account for their recorded transitions beginning at rather lower temperatures. H.H.Hodgson

CRYSTALLOGRAPHY

10229 THE PRODUCTION OF HIGH-QUALITY OPTICAL SURFACES ON CALCITE. R.N.Smartt.
sci. Instrum. (GB), Vol. 38, No. 4, 165 (April, 1961).

A polishing technique is described for obtaining calcite plates t to within 0.2 or 0.1 fringe for use in the $\frac{1}{8}$ A Lyot filter.
A.R.Stokes

10230 GROWTH OF A LEAD SELENIDE LAYER. V.A.Dorin and G.M.Filaretova.
:. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 718-21 (May, 60). In Russian.

The formation of a layer at the solid Pb/liquid Se interface was died by metallographic examination and microhardness measurents. The diffusion layer formed on the Pb surface under these nditions consisted of an inner, PbSe layer, separated from the Pb a sharply defined boundary, followed by a layer of PbSe grains persed in the Se. With rising temperature and increasing time of fusion, the thickness of the inner layer increased, while that of the er layer decreased. The rate of the formation of the PbSe layer air was several times faster than in vacuo. M.H.Sloboda

10231 PREPARATION OF UNDEFORMED SINGLE CRYSTALS OF A PREDETERMINED SHAPE AND WITH A SPECI- ED DEGREE OF SURFACE PURITY.
P.Rybalko, M.A.Bainov and L.M.Katanov.
zi. Metallov i Metallovedenie (USSR), Vol. 9, No. 5, 796-7 ay 1960). In Russian.

A polycrystalline metal specimen, machined to the required ape with one end tapering to a point, was placed in a metal ntainer packed with a fine oxide powder. The function of the cking material was to support the machined specimen, to eserve its shape, and to protect its surface from contamination ring the subsequent treatment which consisted in passing the ntainer through a vertical electric furnace having a temperature adient with its maximum (situated in the centre of the heating ne) slightly exceeding the m.p. of the metal treated. Melting and lidification of the specimen started at the pointed end, and when sufficiently slow rate of travel was employed, the whole specimen lidified as a single crystal. Al and Zn single crystals in the form tensile test pieces with rectangular (8 × 25 mm) and circular mm in diam.) cross-sections of the gauge length were prepared this method, alumina being used as the packing material in the rmer, and zinc oxide in the latter case. M.H.Sloboda

10232 CRYSTAL GROWTH OF CdS IN THE VERTICAL FURNACE. H.Fujisaki and Y.Tanabe.
Phys. Soc. Japan, Vol. 15, No. 1, 204 (Jan., 1960).

CdS crystals were grown by heating CdS powder in closed ica crucibles at 1100°-1150°C for 24-48 hr. The surface struce of the crystals was influenced by the temperature, temperature dient and cooling rate of the furnace. J.Franks

10233 PURIFICATION OF ALKALI HALIDE CRYSTALS THROUGH FRACTIONAL DISTILLATION AND NORMAL EEZING. H.Kanzaki and K.Kido.
Phys. Soc. Japan, Vol. 15, No. 3, 529-30 (March, 1960).

Reagent grade material was purified by fractional distillation vacuum. The low-temperature electrical conductivity of single ystals produced from the fractions were measured and the ncentrations of divalent cation impurities estimated.
D.G.Holloway

10234 A POSSIBLE MECHANISM OF CRYSTAL GROWTH FROM THE MELT AND ITS APPLICATION TO THE OBLEM OF ANOMALOUS SEGREGATION AT CRYSTAL FACETS.
Trainor and B.E.Bartlett.
id-State Electronics (GB), Vol. 2, No. 2-3, 106-14 (March, 1961).

A possible mechanism of crystal growth from the melt is scribed by which stable facets are assumed to grow by nucleation the point of critical supercooling, followed by rapid sheet growth ross the facet. The velocity of this sheet growth would be ependent of the rate of advance of the solid-liquid interface. The chanism is used as the basis of a mathematical treatment of purity segregation at a facet, taking into account the adsorption impurity at the solid-liquid interface. An equation is derived ich relates the apparent segregation coefficient at a facet to the ocity of sheet growth and the degree of impurity adsorption. It shown that, for velocities in the expected range, the value of segregation coefficient trends to a limiting value which may be eater than 1. The application of the theory to the related problem dendrite growth is suggested.

10235 GROWTH OF SINGLE CRYSTALS OF YTTRIUM ALUMINIUM GARNET FROM LEAD OXIDE–LEAD FLUORIDE MELTS. R.A.Lefever, J.W.Torpy and A.B.Chase.
J. appl. Phys. (USA), Vol. 32, No. 5, 962-3 (May 1961).

Unusually large single crystals were grown from these melts. The required melt composition and furnace conditions are reported.
J.Holt

10236 THE EXISTENCE OF PREFERENTIAL ORIENTATIONS IN ZONE REFINED ALUMINIUM CONTAINING SMALL ADDITIONS OF IMPURITY ELEMENTS. C.Frois and O.Dimitrov.
C.R. Acad. Sci (France), Vol. 252, No. 10, 1465-6 (March 6, 1961). In French.

By the addition of small quantities of impurity elements to zone refined aluminium the authors find clearly defined preferred orientations in the subsequent crystal growth. The effect is only observed for a definite range of concentration of the particular impurity element concerned. The observations are substantiated by some previous work by Aust and Rutter [Transactions of the American Institute of Mining Engineers, Vol. 215, No. 1, 119-27 (Feb., 1959)]. R.Bullough

10237 RADIO FREQUENCY TECHNIQUE FOR PULLING OXIDE CRYSTALS WITHOUT EMPLOYING A CRUCIBLE SUSCEPTOR.
F.R.Monforte, F.W.Swanekamp and L.G.Van Uitert.
J. appl. Phys. (USA), Vol. 32, No. 5, 959-60 (May, 1961).

An induction heating method of growing oxide crystals is described in which the outer part of the charge, in contact with the water-cooled coil, remains solid and acts as the crucible. The method was used with manganese ferrite and magnetite.
J.Holt

10238 VAPOR-PHASE GROWTH OF SINGLE CRYSTALS OF II-VI COMPOUNDS. W.W.Piper and S.J.Polich.
J. appl. Phys. (USA), Vol. 32, No. 7, 1278-9 (July, 1961).

A method of growing doped single crystals of II-VI compounds a few cm^3 in size is described. The crystal is grown from the vapour phase in a closed moving crucible which permits an efficient utilization of the charge and flexibility in the dimensions of the crystal.

10239 GROWTH OF SINGLE-CRYSTAL CALCIUM FLUORIDE WITH RARE-EARTH IMPURITIES. H.Guggenheim.
J. appl. Phys. (USA), Vol. 32, No. 7, 1337-8 (July, 1961).

The preparation of large single crystals of CaF_2 by the zone melting and the pulling techniques is reported. Many crystals were doped with rare-earth elements. The ingots showed high optical perfection; they could be used in optical maser studies. The annealing of such crystals is discussed.

10240 ANALOG SIMULATION OF ZONE MELTING. H.L.Mason.
J. Res. Nat. Bur. Stand. (USA), Vol. 65C, No. 2, 97-9 (April-June, 1961).

An analogue computer was used to simulate zone melting in small diameter tungsten rods of 0.2 to 1 cm. Heat balance equations take account of electron bombardment, heat capacity, radial conduction, axial conduction, and surface radiation. Diagrams are given for the chosen spatial subdivision and for the computer mechanization. Predicted temperature–time curves are shown for a rod of 0.4 cm diameter with optimum power input of 650 W. Unsatisfactory operation is predicted for zone melting of a 1 cm rod.

10241 CHUCK DESIGN FOR HOLDING A SILICON ROD IN FLOATING ZONE CRYSTAL GROWING.
N.Hemmat and A.L.MacDonald.
Rev. sci. Instrum. (USA), Vol. 32, No. 5, 601-2 (May, 1961).

GROWTH OF CUBIC FERRITES. See Abstr. 10168

10242 SODIUM CHLORIDE WHISKERS. G.Turchányi and I.Tarján.
Nature (GB), Vol. 190, 79-80 (April 1, 1961).

Patterns obtained on NaCl whiskers grown from the vapour, indicate that spiral growth mechanisms occur. Some photographs are shown. J.Franks

10243 FORMATION CONDITIONS AND STRUCTURE OF THIN EPITAXIAL SILVER FILMS ON ROCKSALT.
B.W.Sloope and C.O.Tiller.
J. appl. Phys. (USA), Vol. 32, No. 7, 1331-6 (July, 1961).

A comprehensive experimental investigation of the effects of formation conditions on the structural characteristics of thin, single-crystal Ag vapour films deposited onto synthetic NaCl single crystals is reported. Formation conditions studied include: preannealing heat treatment of the substrate, postheat treatment of film and substrate, substrate temperature during deposition, and the rate of deposition. It is shown that an epitaxial temperature as such does not exist, and that the minimum deposition temperature for the formation of single-crystal films is rate dependent. Crystalline structure, porosity, and stacking fault density of the films are related to the rate of deposition, deposition temperature, and thickness.

THE ORIENTATION OF EVAPORATED METALLIC LAYERS ON SINGLE CRYSTALS OF COPPER (BASED ON ELECTRON INTERFERENCE STUDIES). See Abstr. 10282

THEORY OF OPTICAL ACTIVITY OF CRYSTALS. See Abstr. 9487

TECHNIQUE FOR THE RAPID, ACCURATE AND STRAIN-FREE MACHINING OF METALLIC SINGLE CRYSTALS. See Abstr. 9240

CRYSTAL LATTICE STRUCTURES

10244 REPRESENTATIONS OF SPACE GROUPS.
I.V.V.Raghavacharyulu.
Canad. J. Phys., Vol. 39, No. 6, 830-40 (June, 1961).

The construction of the irreducible representations of space groups by the little-group method making use of their solvability property is discussed. As an example the two-dimensional space group p4g is considered and all the allowable representations for the groups G^k's of typical wave vectors k of the group p4g are obtained.

10245 X-RAY DIFFRACTION CAMERA FOR THE ALIGNMENT OF LARGE SINGLE CRYSTALS.
R.W.Meyerhoff, D.M.Bailey and J.F.Smith.
Rev. sci. Instrum. (USA), Vol. 32, No. 6, 715-17 (June, 1961).

A back-reflection Laue camera incorporating three rotation axes and three orthogonal translation axes is described. This camera allows for the alignment of large single crystals with a precision of ±0.25°. The degree of single-crystallinity of a specimen may be easily examined. In addition it is possible to mark accurately a crystal for subsequent utilization.

10246 APPLICATION TO THE "RIMSKY RETIGRAPH" OF A MECHANISM WHICH PERMITS CENTRING OF SINGLE CRYSTALS BY AN X-RAY METHOD.
C.Panattoni, E.Frasson and L.Amati.
Ricerca sci. (Italy), Vol. 30, No. 10, 1567-9 (Oct., 1960). In Italian.

One of the synchronous motors of the Rimsky camera (Abstr. 2814 of 1953) is modified so that oscillation photographs may be taken. A.R.Stokes

10247 HIGH TEMPERATURE X-RAY DIFFRACTION TECHNIQUES FOR ACTIVE METALS.
J.J.Hanak and A.H.Daane.
Rev. sci. Instrum. (USA), Vol. 32, No. 6, 712-14 (June, 1961).

Techniques are described for obtaining X-ray diffraction information on active metals at high temperatures. One method was used to 1000°C with rare-earth metals; the other method has been used to 2200°C, with tungsten, and to 1400°C with some of the higher melting rare earths. This later approach permitted measurement of resistance of the specimens versus temperature simultaneously with the diffraction pattern, which made easier the characterizing of the high temperature forms of the metals.

OPTICAL DEMONSTRATION OF BRAGG'S LAW. See Abstr. 9484

10248 DYNAMICAL THEORY OF ELECTRON DIFFRACTION IN LAUE-CASE. II. NUMERICAL CALCULATION OF INTENSITIES. F.Fujimoto.
J. Phys. Soc. Japan, Vol. 15, No. 5, 859-67 (May, 1960).

For Pt I, see Abstr. 19761 of 1960. The intensities of 111 reflections of Al and Au are calculated by the method of power expansion of the scattering matrix given in the previous paper and of 333 reflections, by the use of Feynman (1951) expansion of the scattering matrix. The results are compared with those given by the two-wave approximation and by the kinematical theory. If one allows an error of 3% in the intensity, the critical thickness of the crystal for 40 kV electrons below which the kinematical theory can safely be applied is 60 A and 15 A for Al and for Au, respectively. For higher order reflections such as 333, the deviation of the intensity from those of the two-wave approximation and of the kinematical theory is considerable.

10249 DYNAMICAL THEORY OF ELECTRON DIFFRACTION IN LAUE-CASE. III. FORBIDDEN REFLECTION.
F.Fujimoto.
J. Phys. Soc. Japan, Vol. 15, No. 6, 1022-9 (June, 1960).

The intensity of the forbidden 222-reflection of electrons from germanium at the Bragg position is calculated as the function of the crystal thickness by means of three kinds of approximation, (1) exact solution in the harmonic potential corresponding to the 111-Fourier potential, (2) Feynman expansion of the scattering matrix for the harmonic potential taking account of the influence of the 333-Fourier potential, and (3) expansion of the scattering matrix taking account of the three waves (000), (111) and (222). The integrated intensities of the 222-reflection due to systematic interactions and the 200-reflection due to accidental interactions are also calculated by the expansion of the scattering matrix. The results show that the ratio of the integrated intensity of the 222-reflection to that of the 111-reflection is proportional to the square of crystal thickness and of wavelength, and the ratio of the integrated intensity of the 200-reflection to that of the 222-reflection is independent of wavelength.

10250 DYNAMICAL THEORY OF ELECTRON DIFFRACTION FOR THE ELECTRON MICROSCOPIC IMAGE OF CRYSTAL LATTICES. I. IMAGES OF SINGLE CRYSTALS.
H.Hashimoto, M.Mannami and T.Naiki.
Phil. Trans A (GB), Vol. 253, No. 1033, 459-89 (1961).

The theory is applied to the interpretation of images of lattice planes of plate- and wedge-shaped crystals. The wave functions and corresponding intensities predicting interference fringes on the axit surface of a crystal are derived. It is shown in both cases that the fringes are composed of parallel lines and the spacing of the fringes at the exact Bragg angle coincides with that of the original lattice but the positions of the lines do not coincide with those of potential maxima in the crystal, i.e. intensity profiles of the fringes do not represent the variation of mass-thickness in the crystal. The intensity profiles and the spacings of the fringes vary with the thickness of crystal and the deviation from the Bragg angle. The fringes from a bent plate-shaped crystal, which are formed on the extinction contour bands, show the same spacing as that of the crystal lattice along the centre of the contour but they have an increased or decreased spacing near the edge of the contour. The fringes which are formed on the subsidiary extinction contour also show spacing anomaly; they are shifted by half the corresponding amount for the principal contour. The spacing of the fringes of a wedge-shaped crystal coincides with that of the original lattice at the exact Bragg angle, but the contrast of the lines reverses wherever the thickness of the crystal increases by an amount of $\lambda E/2V_g$ (λ, wave length; E, accelerating potential; V_g Fourier coefficient of inner potential of the crystal). For deviation from the Bragg angle, the spacing of the fringes, in general, does not coincide with that of the original lattice and, moreover, the contrast of the lines reverses wherever the thickness of the crystal increases by an amount of $\lambda E/V_g$. The anomalies of spacing and reversal of contrast which are expected from the present theory were observed in the electron microscopic images of metal-phthalocyanine and sodium faujasite crystals respectively. The effects of absorption by the crystal and divergence of illumination on the contrast of the image are discussed and the possibility of obtaining two-dimensional projections of the atomic arrangement in a crystal by using electron microscopic images is also discussed.

10251 DYNAMICAL THEORY OF ELECTRON DIFFRACTION FOR THE ELECTRON MICROSCOPIC IMAGE OF CRYSTAL LATTICES. II. IMAGE OF SUPERPOSED CRYSTALS (MOIRÉ PATTERN). H.Hashimoto, M.Mannami and T.Naiki.
Phil. Trans A (GB), Vol. 253, No. 1033, 490-516 (1961).

Two cases often observed are treated. They are the cases where two plate-shaped crystals are superposed closely with and without a vacuum layer between them. Resolved lattice images of two superposed crystals are also interpreted. The intensity profiles of the images vary with the thicknesses of the crystals and vacuum layer and with the deviation from the Bragg angle. The shifts of the fringes and anomalies of the contrast which are expected from the present theory were observed in the electron microscopic images of Moiré patterns of cupric sulphide, palladium-gold and platinum-phthalocyanine. The relation between Moiré patterns and crystal structure is also discussed.

10252 X-RAY INVESTIGATION OF LATTICE DISTORTIONS GIVING SHIFTED AND BROADENED REFLECTIONS, APPLICATION OF FOURIER-SERIES METHODS. G.K.Schmidt.

angew. Phys. (Germany), Vol. 13, No. 2, 90-5 (Feb., 1961). German.

Describes a modification of the Fourier-analysis method of rren and Averbach (Abstr. 6755 of 1950) applicable to cases of symmetrical broadening where there is a shift of the line due to ge-scale strain effects. An example based on some measure- nts on cold worked copper is given. A.R.Stokes

10253 MEASUREMENTS OF ANOMALOUS TRANSMISSION AND REFLECTION OF X-RAYS ON GOOD GERMANIUM NGLE CRYSTALS IN THE BRAGG CASE OF INTERFERENCE: OMPARISON WITH THE DYNAMICAL THEORY OF X-RAY TERFERENCE. U.Bonse.

Phys. (Germany), Vol. 161, No. 3, 310-29 (1961). In German.

Transmission curves, rocking curves and integral reflections re measured for very good germanium crystals (some free from slocations), using copper K_α radiation. The agreement with namical theory is generally good, but there are small discrep- cies which may be due to lattice defects. A.R.Stokes

10254 THE ACTUAL STRUCTURE OF CdS SINGLE CRYSTALS. W.Möhling and H.Thiel.

n. Phys. (Germany), Vol. 7, No. 7-8, 381-6 (1961). In German.

The angular disorientations in 30 crystals condensed from the pour phase were determined by means of an X-ray goniometer, d were found to be uncorrelated with the numbers and sizes of rface corrugations on the crystals. The nature of these corru- tions is discussed. A.R.Stokes

10255 A CRYSTALLOGRAPHIC SURVEY OF CARBONS. E.G.Steward and B.P.Cook.

C. J. (GB), Vol. 28, No. 1, 35-44 (Winter, 1960-61).

Treats crystal structure, theories of the graphitizing process, operties of graphite suitable for nuclear reactors, and thermal pansion properties. A.R.Stokes

10256 THE INFLUENCE OF ANISOTROPY ON X-RAY MEASUREMENTS OF LATTICE EXTENSION ON CKEL. K.Kolb and E.Macherauch.

Phys. (Germany), Vol. 162, No. 2, 119-26 (1961). In German.

Measurements on the change in the (420) and (313) spacings polycrystalline nickel under stress are described. The results compared with values calculated from the elastic constants. A.R.Stokes

10257 ON THE STRUCTURE OF THE β-CUBIC MODIFICATION OF SELENIUM.

.Andrievskii and I.D.Nabitovich.

istallografiya (USSR), Vol. 5, No. 3, 465-6 (May-June, 1960). Russian.

Layers about 1000 A thick of the β-modification of selenium re prepared by vacuum evaporation of amorphous selenium on collodion substrates maintained at 20°C. This substrate was solved away, and the selenium films supported on tantalum phragms. The amorphous form could be converted to a second orphous state or to a crystalline form according to the method vacuum thermal treatment: heating the sample from 20° to out 40°C in 1-2 min with further slow heating to 60°C at 1-2 /min changed the nature of the electron diffraction pattern in two fering ways. Further heating at 60°C for 1 hr changed the new orphous form either to the β-cubic modification or to the agonal modification. The lattice constant of the β-cubic form s found to be 6.04 ± 0.01 A, giving 8 atoms/cell for a density 4.8 g cm^{-3}. The space-group is 0_h^7 - Fd3m. The electron fraction pattern is sharpened by heating at 130°C, and above s temperature conversion to the hexagonal form takes place. glish translation in: Soviet Physics—Crystallography (USA), . 5, No. 3, 442-4 (Nov. - Dec., 1960)]. RV.Coates

10258 PERFECTION OF THE LATTICE OF DISLOCATION-FREE SILICON, STUDIED BY THE LATTICE-NSTANT AND DENSITY METHOD.

.Straumanis, P.Borgeaud and W.J.James.

ppl. Phys. (USA), Vol. 32, No. 7, 1382-4 (July, 1961).

The method revealed that a high-purity silicon crystal free of locations has a perfect lattice without an excess of vacant sites interstitials ($n' = 8.0000_4$) within the limits of error, in agreement h the results obtained with the decoration method. The lattice stant of vacuum heated silicon powder of semiconductor purity was 5.43070±0.00004 A; that of the nonheat-treated powder was 5.43081 A at 25°C. The constants determined from crystal chips by the rotating crystal method were lower: between 5.43028--5.43048 A at 25°C. As the constants of each series of measurements could be reproduced very well (s = ±0.00004 A), the lower values suggested the presence of some unknown systematic errors, the magnitude of which is outside the scope of errors due to absorption. The thermal expansion coefficients of all samples between 10°-60°C were $(2.6\pm0.4)\times10^{-6}$/°C. The average density of etched crystal chips was 2.3289±0.0001 g/cm^3. The lower density of the nonetched chips indicated the presence of microcracks, removable by etching, within the distorted surface layers. There was no significant difference in density of bars sawed, or of chips broken from the crystal and etched.

10259 AN X-RAY DIFFRACTION STUDY OF NICKEL OXIDES AND THEIR SOLID SOLUTIONS.

D.P.Bogatskii and I.A.Mineeva.

Fiz. tverdogo Tela (USSR), Sbornik [Supplement] II, 301-5 (1959). In Russian.

The crystal structure and lattice parameters were determined for NiO_2, NiO, Ni_2O_3 and their solid solutions. A.Tybulewicz

10260 CRYSTALLOGRAPHY OF THE Ru—B AND Os—B SYSTEMS. C.P.Kempter and R.J.Fries.

J. chem. Phys. (USA), Vol. 34, No. 6, 1994-5 (June, 1961).

These systems were investigated by X-ray powder diffraction. In addition to Aronsson's hexagonal Ru_7B_3 phase, two new hexagonal Ru—B phases were found: $RuB_2(D_{6h}{}^1$—P6/mmm, $\alpha_0 = 2.852$ A, $c_0 = 2.855$ A) and $Ru_2B_5(D_{6h}{}^4$—P6/mmc, $\alpha_0 = 2.89$ A, $c_0 = 12.81$ A. In the Os—B system, two new hexagonal phases, isomorphous with the latter Ru—B phases, were found: OsB ($\alpha_0 = 2.876$ A, $c_0 = 2.871$ A) and Os_2B_5 ($\alpha_0 = 2.91$ A, $c_0 = 12.91$ A). RuB_2 and OsB_2 are isomorphous with W_2B_5.

10261 THE CRYSTAL STRUCTURE OF BADDELEYITE (MONOCLINIC ZrO_2). N.V.Belov.

Kristallografiya (USSR), Vol. 5, No. 3, 460-1 (May-June, 1960). In Russian.

Review of published data on the monoclinic form of ZrO_2 and a discussion of the structure in relation to other similar structures and in particular the structure of the high-temperature form of ZrO_2. [English translation in: Soviet Physics—Crystallography (USA), Vol. 5, No. 3, 436-7 (Nov.-Dec., 1960)]. J.Iball

10262 STRUCTURE OF A NEW ANTIFERROMAGNETIC $BiFeO_3$. A.I.Zaslavskii and A.G.Tutov.

Dokl. Akad. Nauk SSSR, Vol. 135, No. 4, 815-17 (Dec. 1, 1960). In Russian.

For abstract, see Abstr. 5100 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1257-9 (May-June, 1961)].

10263 THE CRYSTAL STRUCTURE OF K_2TiCl_6. J.A.Bland and S.N.Flengas.

Canad. J. Phys., Vol. 39, No. 6, 941-4 (June, 1961).

The structure was determined from the X-ray diffraction pattern. K_2TiCl_6 is cubic, space group Fm3m, and has a cell side of 9.792 ± 0.005 A. The interatomic distances are: Ti—Cl, 2.35 ± 0.03 A, and K—Cl, 3.46 ± 0.03 A.

10264 ELECTRON-DIFFRACTION DETERMINATION OF THE STRUCTURE OF KAOLINITE. B.B.Zvyagin.

Kristallografiya (USSR), Vol. 5, No. 1, 40-50 (Jan.—Feb., 1960). In Russian.

The structure of a sample of Turbovskii kaolinite was determined from electron diffraction texture (fibre) photographs and from E-M single crystal photographs. The interpretation of the texture photographs is described in detail and from these the parameters of the triclinic unit cell are found to be, a = 5.13, b = 8.89, c = = 7.25 A, $\alpha = 91^0 40'$, $\beta = 104^0 40'$, $\gamma = 90^0$. These agree generally with the parameters obtained from X-ray diffraction [see G.W. Brindley and K.Robinson, Mines Magazine, Vol. 27, 242 (1946)]. Intensities were estimated visually from photographs with multiple exposures. The atomic coordinates were estimated from models of the structure and by comparing observed and calculated structure factors. Fourier projections on the x0z and 0yz planes gave refined coordinates and with the final coordinates the factor $R(= \Sigma\ |Fo| - |Fc|\ /\Sigma|Fo|)$ was 0.21 for the two zones (omitting $00l$ reflections). The structure consists of two-storied kaolinite layers with an octahedral network and a tetrahedral network joined to it so that the upper bases of the octahedra are oriented with their vertices in the negative, and the bases of the tetrahedra in the positive directions of the a axis; the anions in the layers are packed in a cubic pattern. Certain anomalies in the structure are discussed. [English translation in: Soviet Physics – Crystallography (USA), Vol. 5, No. 1, 32-42 (July-Aug., 1960)]. J.Iball

10265 AN X-RAY STUDY OF A SINGLE CRYSTAL OF KAOLINITE. V.A.Drits and A.A.Kashaev.
Kristallografiya (USSR), Vol. 5, No. 2, 224-7 (March-April 1960). In Russian.

A single crystal of Kaolinite 0.2 × 0.2 × 0.01 mm in size was found in the deposit from a very dilute suspension. X-ray rotation, Laue and oscillation photographs were taken with Cu Kα radiation and intensities estimated visually. The crystal was triclinic and the parameters agreed with previous published figures. A structure is determined which is essentially the same as that suggested by Zvyagin (see preceding abstract) with differences in some of the atomic coordinates. The distortions from the ideal lattice resemble these found in a polymorphic form of kaolinite "Dickite" [W.L.Bragg and J. West. Zeitschrift für Kristallographie (Germany), Vol. 69, 118 (1928)]. [English translation in: Soviet Physics — Crystallography, Vol. 5, No. 2, 207-10 (Sept.-Oct. 1960)]. J.Iball

X-RAY TEMPERATURE DIFFUSE SCATTERING OF ANTHRACENE AND STEARIC ACID. See Abstr. 9969

ALLOYS . METALLURGY

10266 THE EFFECT OF PLASTIC DEFORMATION ON THE STRUCTURE AND PROPERTIES OF AN ALUMINIUM–MAGNESIUM ALLOY. N.I.Varich, N.N.Belousov and G.I.Shcherbakov.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 909-17 (June, 1960). In Russian.

The effect of work-hardening on both cast and extruded Al-base alloy containing 11.5% Mg, 0.14% Be, 0.1% Ti, and 0.1% Zr was studied on specimens subjected to various heat and mechanical treatment. The properties investigated included microstructure, elastic limit, yield point, U.T.S., elongation, impact strength, hardness, dimensions of the blocks in the mozaic structure, and the magnitude of stresses of the second and third type. Cold-working increased the strength of both cast and extruded specimens without unduly lowering their impact strength and ductility. However, the extruded material responded more readily to mechanical treatment, its mechanical properties were more stable at both sub-zero and elevated temperatures, and it retained its strength at temperatures slightly higher than the cast alloy did. M.H.Sloboda

10267 X-RAY INVESTIGATION OF NICKEL-CHROMIUM ALLOYS. I.V.Smushkov and I.E.Karakulin.
Fiz. Metallov i Metallovedenie (USSR), Vol. 9, No. 6, 943-5 (June, 1960). In Russian.

The concentration-dependence of the lattice parameter of the Ni—Cr system was determined by X-ray diffraction measurements, and the crystal structure of these alloys was studied. It was concluded that Cr—Ni alloys containing up to 62.8 at.% Cr solidify as homogenous γ-solutions. M.H.Sloboda

10268 SUBMICROSCOPIC CRYSTAL STRUCTURE AND THE MECHANISM OF PLASTIC DEFORMATION OF COPPER-BASE SOLID SOLUTIONS. L.N.Guseva and A.A.Babaréko.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 269-71 (Aug., 1960). In Russian.

X-ray diffraction patterns were obtained for powder specimens (filings) of Cu and Cu-base alloys containing 5-25 at.-% Zn, Al, or Sn. The width of the (111) and (222) lines was measured, the relative part played by micro-stresses in the broadening of X-ray lines was determined, and the size, D, of the regions of coherent scattering was calculated. D decreased with increasing concentration of the solute and increasing difference between the size of the solute and solvent atoms, from which a different mechanism of plastic deformation of Cu and Cu-base alloys was inferred. M.H.Sloboda

10269 A TERNARY PHASE IN THE SYSTEM Ag–Sb–Te. A.Stegherr, F.Wald and P.Eckerlin.
Z. Naturforsch. (Germany), Vol. 16a, No. 1, 130-1 (Jan., 1961). In German.

A rocksalt structure was found between 400° and 530°C, with Te atoms occupying the Na^+ positions of NaCl. The mean lattice parameter is 6.076 A. The compositions on the phase boundary are given. A.R.Stokes

CORRELATION BETWEEN MAGNETIC SUSCEPTIBILITY AND HYDROGEN SOLUBILITY IN ALLOYS OF EARLY TRANSITION ELEMENTS. See Abstr. 10130

10270 THE COMPOSITION OF THE β SOLID SOLUTION IN Ti—Mn ALLOYS. M.A.D'yakova and I.N.Bogachev.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 6, 896-902 (Dec., 1960). In Russian.

The kinetics of phase transformations in a 6.5% Ti—Mn alloy were studied. The temperatures at which the β-phase decomposed into α- and ω-phases were determined. The effect of this decomposition on the hardness, specific volume and electrical resistivity was investigated. A.Tybulewicz

10171 VOLUME CHANGES DURING ORDERING OF THE Ni_3Mn ALLOY. V.I.Mel'nikova and I.N.Bogachev.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 2, 200-6 (Aug., 1960). In Russian.

The results of dilatometric measurements showed that ordering of Mi_3Mn is accompanied by a decrease in volume. Isothermal studies of the kinetics of the volume changes at various temperature revealed that the maximum rate of the change and maximum shrinkage were attained at 450°-475°C from which it was inferred that the rate of isothernal ordering is maximum at these temperatures. The temperature of the disorder—order transformation, determined from the dilatometer curves obtained by heating specimens in the ordered and disordered state, was 475°-520°C. The temperature-dependence of the linear expansion coefficient, α, determined for both ordered and disordered Ni_3Mn, indicated that α is greatly affected by the order—disorder transformation. M.H.Sloboda

SOLUBILITY OF METALS IN MERCURY. See Abstr. 9387

10272 CRYSTALLIZATION OF BINARY ALLOYS UNDER CONDITIONS OF STABLE EQUILIBRIUM.
V.T.Borisov.
Dok. Akad. Nauk SSSR, Vol. 136, No. 3, 583-6 (Jan. 21, 1961). In Russian.

If the solid—liquid interface in a solidifying binary alloy is at equilibrium in respect to temperature and concentration, displacement of the solidification front brings about departure of the system from equilibrium. According to the theory due to Ivantsov (Ibid., Vol. 81, No. 2, 1951), the diffusion-induced degree of supercooling is equal to the temperature interval between the solidus and liquidus of the alloy. However, this theory cannot describe the process of solidification of alloys in which no significant supercooling can occur. For this purpose a theory is required which is based on the condition that the state of equilibrium should exist in every discrete part of the alloy throughout the solidification process. This condition can be satisfied if it is assumed that an intermediate, two-phase region (such as has been postulated by Skvortsov) exists between the solid and liquid phases. A theoretical basis for this assumption for a steady mode of solidification during which crystals grow at a constant rate is provided, and the properties of the two-phase region and the resultant specific features of the solidification process are discussed. [English translation in: Soviet Physics—Doklady (USA), Vol. 6, No. 1, 74-6 (July, 1961)]. M.H.Sloboda

10273 INVESTIGATION OF THE INITIAL STAGES OF AGEING OF ALUMINIUM—ZINC ALLOYS.
M.I.Zakharova and I.I.Eliseeva.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 4, 560-3 (Oct., 1960). In Russian.

Reports X-ray diffraction studies of the initial stages of ageing of aluminium alloys containing 10 or 20% Zn by weight. It was found that in the alloy with 10 % Zn, ageing was accompanied by disordering of blocks (regions of coherent scattering) in the aluminium matrix. The degree of disordering, as measured by the angle of tilt between blocks, rose with the duration of ageing at 150°C, reaching maxima which were different in individual monocrystals. A.Tybulewicz

10274 PRECIPITATION OF COPPER IN SILICON. H.Rieger and K.Seiler.
Z. Naturforsch. (Germany), Vol. 16a, No. 2, 220-1 (Feb., 1961). In German.

Cu was diffused into Si single crystals above 900°C, the distribution of precipitated Cu after quenching was observed with a microscope and image converter. The amount of precipitated Cu increased with decreasing quenching rate and increasing diffusion temperature. Plate and needle precipitates of Cu were oriented crystallographically at dislocations and also at point defects and vacancies. J.Franks

OTHER SOLID FORMS

10275 THE ANISOTROPY OF YOUNG'S MODULUS IN DRAWN POLYETHYLENE.
Raumann and D.W.Saunders.
roc. Phys. Soc. (GB), Vol. 77, Pt 5, 1028-37 (May, 1961).

The anisotropy in samples drawn by simple tensile loading so to have transverse isotropy, was studied experimentally at 20° C. ccording to classical elasticity theory the Young's modulus of a ansversely isotropic material can be defined completely in terms three independent parameters. These were chosen to be E_0, $_5$ and E_{90}, the Young's moduli at angles 0°, 45° and 90° to the mmetry axis respectively. It is found that (a): the polar distribu- on of Young's modulus in highly drawn polyethylene (draw ratio 65) agrees well with the distribution predicted by classical asticity theory; (b) at draw ratios up to approximately 1.2, E_0, $_5$ and E_{90} all decrease from the isotropic value and $E_{45} > E_{90} > E_0$; at draw ratios greater than 1.2, E_0 and E_{90} both increase with creasing draw ratio but E_{45} continues to decrease; (d) in the ghly drawn material, draw ratio approximately 4.65,

$$E_0 \cong 1.5\,E_{90} \cong 12\,E_{45} \cong 5\,E_{\mathrm{isotropic}}.$$

ese results are discussed in terms of the classical theory of asticity.

10276 INFLUENCE OF PRESSURE ON THE PROCESS OF COALESCENCE AND "HEALING" OF MICROPORES CRYSTALLINE BODIES. Ya.E.Geguzin.
okl. Akad. Nauk SSSR, Vol. 135, No. 4, 829-32 (Dec. 1, 1960).
Russian.

For abstract, see Abstr. 4075 of 1961. [English translation in: oviet Physics—Doklady (USA), Vol. 5, No. 6, 1338-42 (May-June, 961)].

10277 THE STRUCTURE OF VERY THIN COPPER WIRES. É.M.Nadgornyĭ and B.I.Smirnov.
Fiz. tverdogo Tela (USSR), Vol. 2, No. 12, 3048-9 (Dec., 1960).
n Russian.

Very thin (4-17 μ diameter) copper wires were obtained by rawing molten metal. Wires thinner than 14 μ were monocrystals vith the [001] direction along the wire axis. Thicker wires were coarse-grained polycrystals. [English translation in: Soviet Physics—Solid State (USA) Vol. 2, No. 12, 2707-8 (June, 1961)].
A.Tybulewicz

urfaces . Films . Adsorption

10278 SURFACE STRUCTURE OF CLEAVED NaCl SINGLE CRYSTALS. H.Bethge, G.Kästner and M.Krohn.
. Naturforsch. (Germany), Vol. 16a, No. 3, 321-2 (March, 1961).
German.

Electron micrographs of surfaces cleaved in vacuum differed rom surfaces cleaved in air. These differences are related to e prescence of water vapour, and the possibility of recrystalisa- on on the cleaved surface is considered. J.E.Caffyn

10279 TEXTURE TRANSITION IN HIGH-PURITY SILVER AND ITS CORRELATION WITH STACKING FAULT REQUENCY. H.Hu, R.S.Cline and S.R.Goodman.
appl. Phys. (USA), Vol. 32, No. 7, 1392-9 (July, 1961).

The rolling texture of high-purity silver is found to change adually from the common silver type to the copper type as the mperature of deformation increases. The transition is completed the temperature range 150°-200°C. There is a general correlation tween the texture transition and the change in stacking fault equency as a function of rolling temperature. On the basis of such correlation, the texture transition produced by varying the temp- ature of deformation, or by alloy additions, can be consistently terpreted in terms of a change in the stacking fault energy, a ange in the dislocation density, or both.

10280 CONTRIBUTION TO THE STUDY OF THE ORIENTATION OF SILVER ON SODIUM CHLORIDE.
Gillet, E.Gillet and R.Zouckermann.
R. Acad. Sci. (France), Vol. 252, No. 13, 1925-7 (March 27, 1961).
French.

Films of silver whose thickness varied from 50 to 500 A were epared by vacuum evaporation onto a sodium chloride substrate. ey were examined by electron microscopy and micro-diffraction to study factors determining their orientation, the main ones being the speed of evaporation, the temperature and microstructure of the sodium chloride surface. Residual gases at 10^{-5} to 10^{-6} mm Hg had little influence. Results agree with previous workers using indirect methods. V.R.Switsur

10281 THE OXIDE FILMS FORMED ON COPPER SINGLE CRYSTAL SURFACES IN WATER. II. RATE OF GROWTH AT ROOM TEMPERATURE. J.Kruger.
J. Electrochem. Soc. (USA), Vol. 108, No. 6, 503-9 (June, 1961).

For Pt I see Ibid., Vol. 106, No. 10, 847 (Oct., 1959). Measurements utilizing polarized light were made of the increase in film thickness with time on {100}, {110}, {111}, and {311} surfaces of a copper single crystal immersed in water in equilibrium with atmospheres containing either oxygen or oxygen—helium mixtures containing 1, 10, or 20% oxygen. With the oxygen atmosphere, a Cu_2O film rapidly reached a limiting thickness that remained constant for 1.5 to 2 hr after which time the formation of CuO was observed. Stirring increased the time required to observe the formation of CuO. Similar behaviour was observed for 10% and 20% oxygen atmospheres; the limiting film thickness of Cu_2O and the time required to observe the formation of CuO increased with decreasing oxygen content in the atmosphere. When a 1% oxygen atmosphere was used, parabolic film growth was observed. In all cases the {111} plane exhibited the lowest growth rate.

10282 THE ORIENTATION OF EVAPORATED METALLIC LAYERS ON SINGLE CRYSTALS OF COPPER (BASED ON ELECTRON INTERFERENCE STUDIES). O.Haase.
Z. Naturforsch. (Germany), Vol. 16a, No. 2, 202-6 (Feb., 1961).
In German.

The deposition of evaporated Cu, Pd, Ni, Au, Ag, Fe and Zn on the (111) face of a copper crystal (maintained at room temperature) shows regular orientation. On the (110) face, only Cu deposits in an ordered manner. On the (100) face, no orientation is observed but on raising the temperature to 400°C Ni, Pd and Fe orientate parallel to the crystal edges with Au and Ag partially so.
R.Reed

10283 THE ANALYSIS OF VERY THIN SURFACE LAYERS ON SINGLE CRYSTALS OF COPPER (AN ELECTRON INTERFERENCE STUDY). O.Haase.
Z. Naturforsch. (Germany), Vol. 16a, No. 2, 206-8 (Feb., 1961).
In German.

The reflection patterns from the electrolytically polished (100) face, before and after the evaporation of Fe, Pd and Ni layers, were observed. Such surface layers are uniform and by measuring their rate of build-up and removal they are shown to consist of a few layers of atoms. R.Reed

EVAPORATED SELENIUM FILMS FOR USE IN Hα PHOTOGRAPHY. See Abstr. 9491

MEASURING THE THICKNESS OF THIN CELLULOID FILMS. See Abstr. 9358

OBTAINING A REPLICA FROM A TRANSVERSE SECTION OF A THIN FILM. See Abstr. 10284

MICROSTRUCTURE EXAMINATION

(By X-rays and Electron and Other Microscopes)

10284 OBTAINING A REPLICA FROM A TRANSVERSE SECTION OF A THIN FILM.
R.Ya.Berlaga and M.I.Rudenok.
Fiz. tverdogo Tela (USSR), Vol. 3, No. 2, 625-6 (Feb., 1961).
In Russian.

Describes a method of taking a replica of a transverse section of a thin film of brittle material, e.g. lead sulphide, without the need for a microtome. The film is mounted on glass; the glass is fractured and the fracture surface is coated with an aluminium film followed by an evaporated carbon film. The aluminium is dissolved in hydrochloric acid leaving a carbon replica of the fracture surface of the lead sulphide as well as the adjacent area. The replica is then examined in the electron microscope. [English translation in: Soviet Physics—Solid State (USA)]. A.E.I.Research Laboratory

10285 SOME ELECTRON MICROSCOPIC OBSERVATIONS ON SINGLE CRYSTALS OF POLYETHYLENE.
R.Westrik and A.M.Kiel.
Nature (GB), Vol. 190, 162-3 (April 8, 1961).

In dilute solutions of polyethylene, single crystals form and these can be observed with an electron microscope. Under the electron beam however the crystals change and it is not possible to obtain satisfactory stereo-micrographs. To avoid this difficulty pre-shadowed carbon replicas of polyethylene crystals were prepared and stereographs of these were obtained with the electron microscope. These confirmed that the crystals had a pyramidal structure and some of the plates showed that the striations were straight. In some of the replicas it is possible to see both a pyramidal and a terraced structure. J.Iball

10286 ELECTRON MICROSCOPE EXAMINATION OF RAPIDLY GROWN SPINEL SINGLE CRYSTALS.
E.Brüche and K.J.Schulze.
Z.Naturforsch. (Germany), Vol. 16a, No. 1, 20-4 (Jan., 1961).
In German.

$MgAl_2O_4$ is used to illustrate the application of electron microscope studies of the surfaces of small, approximately spherical crystals to the determination of crystal structures. Surface growth patterns interpreted in terms of the known crystal structure are in agreement with macroscopic spherical crystal methods. J.Holt

TRANSMISSION ELECTRON MICROSCOPE OBSERVATIONS OF MAGNETIC DOMAIN WALLS. See Abstr. 10153

10287 NEUTRON RADIOGRAPHY.
J.Thewlis.
Progress in non-destructive testing. Vol. 1 (see Abstr. 9238 of 1961) p. 111-26.

The potentialities of the use of thermal neutrons to supplement X-rays and γ-rays for radiography are considered. Various types of neutron source are discussed; an account is given of the physical principles of neutron absorption; details are given of the techniques available for neutron radiography; and a few neutron radiographs are reproduced. J.B.Birks

PHYSICAL CHEMISTRY

10288 TECHNIQUE FOR DETERMINATION OF MOLECULAR WEIGHT WITH A SMALL VOLUME.
B.Wilkins, J.A.Knight and F.Sicilio.
Rev. sci. Instrum. (USA), Vol. 32, No. 3, 355-6 (March, 1961).

The freezing point depression method is used to determine the molecular weight of a minute amount of material by means of a single thermistor and Wheatstone bridge arrangement. Typical cooling curves obtained for benzene and a benzene solution are given. G.I.W.Llewelyn

10289 MAGNETICALLY SUSPENDED EQUILIBRIUM ULTRACENTRIFUGE.
J.W.Beams, R.D.Boyle and P.E.Hexner.
Rev. sci. Instrum. (USA), Vol. 32, No. 6, 645-50 (June, 1961).

An improved ultracentrifuge is described for the determination of molecular weights and molecular weight averages. The rotor is magnetically suspended in a vacuum. The rotor is driven to operating speed by an electric motor or by an air turbine. The rotor is allowed to "coast" freely during the course of the sedimentation and loses about 1 r/s per day. An improved Jamin interferometer is used to measure the concentration in the ultracentrifuge cell both before and after equilibrium has been established. A precision of the order of 0.1% is obtained for monodisperse substances over a very wide molecular weight range.

THERMOCHEMISTRY . REACTIONS

10290 ENTROPY OF MIXING OF INTERCONVERTIBLE SPECIES. SOME REFLECTIONS ON THE GIBBS PARADOX. R.M.Noyes.
J. chem. Phys. (USA), Vol. 34, No. 6, 1983-5 (June, 1961).

Expressions are derived for the change of state when two separated but interconvertible species are allowed to mix and come to chemical equilibrium. These expressions are unaffected by the possible existence of an exchange process involving simultaneous interconversion of two molecules. The results emphasize that entropy concepts are intimately connected with the distinguishability of chemical species and that the original concern of Gibbs arose because distinguishability is usually employed as a discontinuous concept. The discontinuity could be removed in specific cases by recognizing the finite limits to distinguishability imposed by existing analytical procedures.

10291 ISOTOPIC SEPARATION FACTOR FOR THE SYSTEM POTASSIUM AMALGAM—AQUEOUS POTASSIUM HYDROXIDE. H.H.Garretson and J.S.Drury.
J. chem. Phys. (USA), Vol. 34, No. 6, 1957-8 (June, 1961).

The isotopic fractionation of potassium between potassium amalgam and aqueous potassium hydroxide was measured at room temperature. The single-stage separation factor was 1.006 ± 0.002 (95% C.I.).

10292 HIGH FREQUENCY FACTORS IN UNIMOLECULAR REACTIONS. C.Steel and K.J.Laidler.
J. chem. Phys. (USA), Vol. 34, No. 5, 1827-35 (May, 1961).

High-frequency factors are associated with two main classes of unimolecular reactions: (1) reactions in which two bonds are ruptured simultaneously, and (2) certain dissociation reactions in which only one bond is broken, such as the decomposition of ethane into two methyl radicals. These high values are related to the entropy increases occurring during the rupture of the bond or bonds, and a discussion is given of the way in which the entropy may change during the process. For the reactions of type (2) the data are consistent with the view that the entropy change occurs well before the bond is completely ruptured. For reactions of both types the rates at low pressures (i.e., the rates of energization) are probably not affected by such entropy increases, so that the pressures at which transition occurs from first to second order will be abnormally high for such reactions; this point of view is supported by detailed calculations for five reactions. The entropy changes during the course of reaction are interpreted as being due to a "softening" of molecular vibrations in the activated state.

10293 CONVENIENT REACTOR FOR STUDYING REACTION KINETICS OF HIGH BOILING LIQUIDS IN THE GAS PHASE. G.G.Smith and F.D.Bagley.
Rev. sci. Instrum. (USA), Vol. 32, No. 6, 703-5 (June, 1961).

A new reactor was built which provides a means of rapid, easy introduction of the reactant and careful monitoring of pressure changes. Reaction rates were determined for the pyrolysis of 1,2-diarylethyl acetates.

10294 COMPETITIVE REACTION RATES OF HYDROGEN ATOMS WITH HCl AND Cl_2. ENTROPY CONSIDERATIONS OF THE HCl_2 TRANSITION STATE.
F.S.Klein and M.Wolfsberg.
J. chem. Phys. (USA), Vol. 34, No. 5, 1494-8 (May, 1961).

The relative rates of the reactions

$$H + HCl \xrightarrow{k_3} H_2 + Cl$$

and

$$H + Cl_2 \xrightarrow{k_6} HCl + Cl,$$

were determined in the temperature range of 0° to 62°C and found to be given by

$$k_3/k_6 = (0.143 \pm 0.033)\exp-(1540 \pm 130/RT).$$

The temperature-independent factor in this expression is interprel in terms of the structure and the vibrational frequencies of the Cl_2 transition state. The doubly degenerate bending frequency of s transition state is found to have a value of about 105 cm^{-1}.

10295 SHOCK TUBE DETERMINATION OF DISSOCIATION RATES OF OXYGEN.
P.Rink, H.T.Knight and R.E.Duff.
chem. Phys. (USA), Vol. 34, No. 6, 1942-7 (June, 1961).

The rate of dissociation of oxygen in $Xe-O_2$ mixtures was easured over a temperature range of 3000°K to 6000°K. An X-ray nsitometer was used to measure the density during the dissoation process behind a shock wave. It was possible to match the perimental data with theoretical density profiles over a wide nge of compositions and initial conditions. The reactions conlered were

$$O_2 + M \underset{k_r}{\overset{kd}{\rightleftarrows}} 2O + M,$$

ere M can be Xe, O_2, or O. Considering these species as third dies, the deduced recombination rates in $cc^2\ mole^{-2}\ sec^{-1}$ were $\times 10^{17}\ T^{-1}$, $1.6 \times 10^{18}\ T^{-1}$, and $4.8 \times 10^{18}\ T^{-1}$, respectively. The rd-body efficiencies of O_2 and O relative to Xe are 3 and 10. perimental conditions were such that an accurate measurement the exponent of the temperature could not be made. However, nce the data showed it to be within the limits of $-\frac{1}{2}$ and -2, a lue of -1.0 was arbitrarily chosen. The agreement between reilts reported here and previous work demonstrates the potential lity of this method for kinetic studies of other reactions.

10296 THE EFFECT OF ULTRASOUND ON CATALYTIC PROPERTIES OF MnO_2 GELS AND SUSPENSIONS.
Gregush and P.Gregush.
ust. Zh. (USSR), Vol. 6, No. 4, 441-5 (1960). In Russian.

Describes a study of the effect of ultrasound on catalysis of O_2 decomposition with MnO_2 gels and suspensions. The curves oxygen yield as a function of time had a characteristic maximum the case of systems subjected to ultrasound; they were similar the adsorption curves. [English translation in: Soviet Physics — coustics (USA), Vol. 6, No. 4, 442-6 (April-June, 1961)].
A.Tybulewicz

PHOTOCHEMISTRY RADIATION CHEMISTRY

10297 MODELS FOR THE MECHANISM OF IRRADIATION-INDUCED REVERSIBLE CHANGES IN CERTAIN GANIC COMPOUNDS. R.Heiligman.
handl. Deutschen Akad. Wiss. Berlin Kl. Math. Phys. Tech. ermany), 1960, No. 7, 265-77.

"Electron processes in solids" Conference (see Abstr. 2382 of 1961). A kinetic study of the reversible photo-isomerization of spiropyran to merocyanine has been carried out. Mechanisms for this reaction are considered and a model of the potential barrier between excited states proposed.
G.I.W.Llewelyn

10298 EFFECT OF INERT-GAS MODERATORS ON THE (n, γ) ACTIVATED REACTION OF I^{128} WITH CH_4.
E.P.Rack and A.A.Gordus.
J. chem. Phys. (USA), Vol. 34, No. 6, 1855-60 (June, 1961).

In the presence of a large excess of gaseous methane, 54.4 ± 0.5% of I^{128} formed by (n, γ) activation was found to become stabilized in organic combination. The effects of inert-gas additives in moderating the reaction of I^{128} with CH_4 were determined in an effort to ascertain the mechanism. The data, extrapolated to zero mole-fraction methane, indicate that xenon is capable of reducing the organic I^{128} to 11% whereas neon, argon, and krypton each reduce it to only about 36%. These data suggest that of the 54.4% organic I^{128}, about 18.4% forms as a result of hot I^{128} reactions, 11% as a result of excited iodine atoms or I^+ ions in the $^3P_2$, $^3P_1$, and/or $^3P_0$ states, and 25% as a result of reactions of $I^+(^1D_2)$ ions.

MECHANISMS OF PHOTOGRAPHIC IMAGE FORMATION. See Abstr. 9490

PHYSICAL METHODS OF CHEMICAL ANALYSIS

10299 FIGURE OF MERIT FOR THE SPECTROMETRIC ANALYSIS OF SMALL SAMPLES. G.S.Stanford.
J. Opt. Soc. Amer., Vol. 51, No. 7, 773-5 (July, 1961).

In deciding between alternative sampling systems for the absorption spectrometric analysis of a small quantity of material, a useful figure of merit is the quantity LT/V, where L is the length of the light path in the sample, V is the volume occupied by the sample, and T is the fractional beam energy passed by the sampling system when none of the sample material is present. It is shown that LT/V is inversely proportional to the amount of sample required for analysis, permitting the direct comparison of such diverse approaches as the KBr micropellet technique and low-concentration gas analysis.

FIGURE OF MERIT FOR THE SPECTROMETRIC ANALYSIS OF SMALL SAMPLES. See Abstr. 10299

GEOPHYSICS

10300 PALEOMAGNETIC EVIDENCE RELEVANT TO A CHANGE IN THE EARTH'S RADIUS.
S.W.Carey; A.Cox and R.R.Doell.
Nature (GB), Vol. 190, 36, 36-7 (April 1, 1961).

Using paleomagnetic measurements relating to the Permian in a region in Siberia and in Europe, Cox and Doell found (Abstr. 5132 of 1961) no evidence to support a substantial post-Palaeozoic expansion of the earth such as Carey had deduced on tectonic grounds. Carey explains that their interpertation of his hypothesis is invalid because a dilatation occurred between the two areas of measurement. According to Carey the magnetic data used by Cox and Doell are in fact consistent with his tectonic synthesis. Cox and Doell reply that they understood Carey's expansion of the earth to be of the type in which most or all of the increase in area occurs in the ocean basins; but, more particularly, the line of dilatation in Carey's model is inclined at 50° to the meridian through the two sampling areas, and therefore the component of elongation could not mask an expansion of the amount required. J.M.Stagg

LONGITUDE TERMS IN THE EARTH'S EXTERNAL GRAVITATIONAL POTENTIAL. See Abstr. 9297

THE MOTION OF A SATELLITE IN AN AXI-SYMMETRIC GRAVITATIONAL FIELD. See Abstr. 9300

10301 A STUDY OF ACOUSTIC PROPERTIES OF SUBMERGED SOIL AT HIGH FREQUENCIES. N.A.Grubnik.
Akust. Zh. (USSR), Vol. 6, No. 4, 446-53 (1960). In Russian.

Describes a method of measuring the reflection coefficient of submerged soils as a function of frequency and angle of incidence. Gives acoustic properties of some soils obtained by this method in lakes and seas. [English translation in: Soviet Physics — Acoustics (USA), Vol. 6, No. 4, 447-54 (April-June, 1961)]. A.Tybulewicz

10302 ROTATIONAL MULTIPLETS IN THE SPECTRUM OF THE EARTH. C.L.Pekeris, Z.Alterman and H.Jarosch.
Phys. Rev. (USA), Vol. 122, No. 6, 1692-1700 (June 15, 1961).

The doublets in the spectrum of the free oscillations of the earth which have been observed on the gravimetric (UCLA) and strainmeter (Pasadena) records of the great Chilean earthquake of May 22, 1960, are interpreted as multiplets arising from the rotation of the earth. The phenomenon is similar to the Zeeman effect, and is indeed a realization of the mechanical analogue from which Larmor deduced the "Larmor precession" in his interpretation of the Zeeman effect. A first-order perturbation calculation yields the result that the degenerate frequency $\sigma_0(n)$ in the absence of rotation is resolved by a slow rotation into $(2n + 1)$ lines, $\sigma_n{}^m$ given by $\sigma_n{}^m = \sigma_0(n) + m\ (n)\omega$, $-n \le m \le n$, where ω denotes the angular velocity of rotation of the earth, and m is the azimuthal number of the wave-function. $\tau(n)$ is determinable from the zero-order solution in the case of spheroidal oscillations, and is equal to $[n(n + 1)]^{-1}$ in the case of purely torsional oscillations. The relative intensities within the quintet $n = 2$ and the septet $n = 3$ have been determined for an observing station at Los Angeles, on the assumption of an explosive point-source at the earthquake focus in Chile. The strongest lines should be the pair $m = \pm1$ for $n = 2$, and the pair $m = \pm2$ for $n = 3$. These agree in separation with the pairs observed on the strain-meter and with the gravimetric pair at $n = 3$, but less so with the gravimetric pair at $n = 2$. There are indications in the strain-meter spectrum for $n = 3$ of a weaker line at $m = 0$, while the other lines are theoretically of an intensity not exceeding the background noise. The separation in the observed gravimetric doublet for the first overtone of $n = 3$ agrees with the interval of the strongest pair $m = \pm2$. The intensities of the lines in the rotational multiplets of the components of displacement for an observing station at Palisades, New York, have also been determined.

10303 ANALYSIS OF INEQUALITIES IN THE ROTATION OF THE EARTH. I. METHOD, AND THE ANNUAL TERM.
A.Danjon.
C.R. Acad. Sci. (France), Vol. 252, No. 14, 2039-44 (April 5, 1961). In French.

Discusses analytical methods used in reducing the time-service observations with the impersonal astrolabe (Abstr. 2092 of 1958) made at the Paris Observatory from 1956 to 1960. The corrections needed to eliminate certain systematic errors are described. The Analysis reveals a periodic "annual term", denoted by the sum of four non-Chandlerian polar terms, that varies from one latitude station to another. Curves are reproduced to show a comparison of the annual curve obtained at Paris with those for Herstmonceux, Neufchâtel, and Washington. D.R.Barber

10304 THE SWEEP OF LONG WATER WAVES ACROSS THE PACIFIC OCEAN. R.Green.
Austral. J. Phys., Vol. 14, No. 1, 120-8 (March, 1961).

Seismic sea waves (tsunamis) are shallow water waves. The leading tsunami wave from the Chilean earthquake of May 22, 1960 a 19 hr 11 min 20 s G.M.T. arrived at Hobart in 12 hr. The tsunami was also recorded on tide guages up the east coast of Australia and at Norfolk and Lord Howe Islands. The wave took 14 hr 04 min to reach Auckland, N.Z., but this is because of the low speed of the wave over the extensive submerged continental structure off the eastern coast of North Island. The tsunami was not recorded at Por Melbourne. From the travel-times the average depth of the Pacific Ocean between Tasmania and South America is 5500 m.

ATMOSPHERE

(Troposphere and Stratosphere)

10305 POSSIBLE PHYSICAL EFFECT OF SOLAR PARTICLES ON METEOROLOGICAL PARAMETERS IN ALASKA. A.L.Julius, Jr.
Science (USA), Vol. 133, 1707-8 (May 26, 1961).

Statistical significance was found in the reception of solar-particle invasions to sea-level pressure and upper-flow pattern changes at 500 mb in Alaska during a period of high solar activity. Recent IGY findings suggest that a physical relation exists between such solar particles and atmospheric changes.

10306 A WORLD-WIDE STRATOSPHERIC AEROSOL LAYER. C.E.Junge, C.W.Chagnon and J.E.Manson.
Science (USA), Vol. 133, 1478-9 (May 12, 1961).

An aerosol layer was identified by a stratospheric balloon and aircraft aerosol collection programme. Measurements of horizonta extension and vertical distribution indicate that this layer is a world-wide phenomenon, displaying little variation with time and latitude. The particles in this layer range in size between 0.1 and 2 μ in radius, are water soluble, and contain sulphur as the predominant constituent. It is most likely that they are formed within the stratosphere.

10307 DIURNAL AND CYCLIC VARIATIONS OF THE INTENSITY OF NATURAL RADIO NOISE OF VERY LOW FREQUENCY. C.Renard.
C.R. Acad. Sci. (France), Vol. 252, No. 9, 1365-7 (Feb. 27, 1961). In French.

Statistical studies of recordings made at Kerguelen during 1959-60 reveal a diurnal variation of intensity of dawn chorus (with a maximum at 8h 40 m L.M.T.) and a semi-diurnal variation of hiss (with maxima at 9h and 21h 40 m L.M.T.). Possible production mechanisms are discussed. G.M.Brown

10308 A STUDY OF WHISTLING ATMOSPHERICS. I. OCCURRENCE. J.Crouchley.
Austral. J. Phys., Vol. 14, No. 1, 22-39 (March, 1961).

The occurrence of whistling atmospherics at four Australian stations (Brisbane, Adelaide, Hobart, and Macquarie Island) over the I.G.Y. period is discussed. A strong seasonal variation is observed at each station, with the maximum occurrence during local winter, and also a strong diurnal variation with a minimum during daylight hours. Whistlers are observed more commonly at about geomagneti latitude 45°. Autocorrelation analysis suggests recurrence tendenci in the occurrence figures and cross-correlation with sunspot numbers and Adelaide data indicates an association between the two. There is little evidence of association between whistler occurence and magnetic planetary index.

10309 A STUDY OF WHISTLING ATMOSPHERICS.
II. DIFFUSENESS.
Crouchley and R.J.Finn.
stral. J. Phys., Vol. 14, No. 1, 40-56 (March, 1961).

The diffuseness or spread, in time, of whistlers observed at four
stralian stations is discussed. It is found to be approximately
ce as large for long as for short whistlers, to be independent of
ason and time of day, and to be linearly related to geomagnetic
itude and whistler dispersion. The diffuseness may be accounted
by assuming that the energy travels over a range of paths in the
osphere, and estimates of this range are made (i) assuming a
ooth variation of dispersion with latitude and (ii) assuming a duct-
e of guiding.

10310 THE CURRENT-JET HYPOTHESIS OF WHISTLER
GENERATION. W.C.Hoffman.
anet. Space Sci. (GB), Vol. 7, No. 1, 72-3 (Oct., 1959).

A new theory of whistler generation is outlined in which the
ficulties of penetration of the sferic signals through the lower
osphere, where the collisional frequency is high, are met by
stulating that the top of the thundercloud emits a high-energy
rrent jet. This is accelerated by the electrostatic field of the
nderstorm and becomes field-aligned during passage through
lower ionosphere in such a way that the thunderstorm creates
own duct of ionization. G.M.Brown

10311 A STUDY OF "CHORUS" OBSERVED AT AUSTRALIAN
STATIONS. J.Crouchley and N.M.Brice.
anet. Space Sci. (GB), Vol. 2, No. 4, 238-45 (Aug., 1960).

The very-low-frequency emission known as "chorus" was
died for four Australian recording stations. The phenomenon
hibits a maximum of occurrence at about geomagnetic latitude 60°
l occurs only about one-tenth as frequently at geomagnetic
itude 45°. It was never definitely observed at geomagnetic
itude 35°. Marked diurnal variations are present with morning
aks for all stations and also an evening peak at Adelaide and
bart. Analysis of the diurnal variations suggests that two
ferent mechanisms are involved. The average strength of chorus
creases with increasing value of K-index at lower latitude
tions and shows a maximum at moderate values of the index for
omagnetic latitude 61°. This is interpreted as meaning that the
gion of maximum average-chorus-strength moves towards lower
itudes at times of magnetic disturbance.

10312 RECENT RESULTS IN THE INVESTIGATION OF THE
RELATION BETWEEN LIGHTNING DISCHARGES AND
HISTLERS. H.Norinder and E.Knudsen.
anet. Space Sci. (GB), Vol. 5, No. 1, 46-9 (Jan., 1961).

A station for research into the relation between lightning
scharges and whistlers has been operated near Uppsala. For
eliminary results see Abstr. 6593 of 1961. Further analysis of
data obtained was carried out. It was possible by harmonic
alysis to show that lightning discharges producing whistlers have
pronounced energy peak around 5 kc/s. From a comparison of
ne intervals of multiple lightning discharges recorded by a
thode-ray oscillograph and from corresponding records of multiple
istlers on sonagrams full agreement in time variation between
two phenomena was demonstrated.

10313 SEASONAL VARIATION AND AGE OF RADIOACTIVE
FALL-OUT. R.P.Parker and J.O.Crookall.
ture (GB), Vol. 190, 574-6 (May 13, 1961).

THE CONCENTRATION IN AIR OF SMALL AND LARGE
DIOACTIVE IONS. See Abstr. 9821

UPPER ATMOSPHERE IONOSPHERE

(See also Space Research. Abstracts on radiowave propagation in ionized media will also be found under Electromagnetic Waves)

10314 MAN-MADE HEATING AND IONIZATION OF THE UPPER ATMOSPHERE. P.A.Clavier.
J. appl. Phys. (USA), Vol. 32, No. 4, 570-7 (April, 1961).

Absorption of radio signals by cyclotron resonance is shown to be possible within a very narrow layer of the atmosphere (20 km thick just below 100 km). For a plane-polarized signal only 25% of the power can be absorbed. Better results are obtained (50%) with a circularly polarized radiowave. The absorbable power is limited by the effects obtained so that an electron density of 3000 cm^{-3} and an electron temperature of 1600°K cannot be exceeded. The reason for this is the weakness of the earth's magnetic field. See also Abstr. 8391 of 1961.

10315 A METHOD FOR OBTAINING THE ATMOSPHERIC TEMPERATURE AND WIND VELOCITY FROM SOUND PROPAGATION IN THE ROCKET SOUNDING.
Y.Takeya and T.Okumoto.
Mem. Fac. Engng Osaka City Univ. (Japan), Vol. 1, 133-40 (Dec., 1959).

The space to be investigated is divided into several layers, in each of which the distributions of temperature and wind velocity are assumed to take the form of quadratic equation with amplitude. In this assumption the formulae to deduce the temperature and the wind velocity are given by use of Snell's law for sound propagation under the existence of a wind. As the results involve hyperelliptic integrals, it is difficult to get explicitly the quantities giving the distributions of temperature and wind velocity. But it is possible to find the numerical values of the required quantities by numerical calculus of the integral. It is shown that in general the results are determined uniquely; the practical application of the theory is described.

10316 AN ANNUAL VARIATION OF DENSITY IN THE HIGHEST LAYERS OF THE EARTH'S ATMOSPHERE.
H.K.Paetzold.
Z. Naturforsch. (Germany), Vol. 16a, No. 1, 50-6 (Jan., 1961).
In German.

From three years' available data from satellites it is now clear that there are three principal kinds of variation of density in the atmosphere above 200 km. One is attributable to solar short-wave radiation — the day—night effect, a second to solar corpuscular radiation and therefore associated with magnetic storms, and a third, the annual variation. This last is a true world-wide effect having a sharp minimum from May to August and a broad maximum from September to April which also includes a secondary January minimum. A semi-annual as well as an annual wave is recognizable. The author discusses several possible explanations of these annual effects. J.M.Stagg

10317 STRUCTURE, VARIATIONS AND MEASUREMENTS OF THE EARTH'S IONOSPHERE AND EXOSPHERE.
C.Altman.
Bull. Res. Coun. Israel, Vol. 9C, No. 1-2, 39-48 (Feb., 1961).

Review, with 38 references.

IONOSPHERIC RESEARCH USING ARTIFICIAL SATELLITES AND ROCKETS. See Abstr. 9303

10318 AIR DENSITY IN THE IONOSPHERE AND EXOSPHERE. H.K.Paetzold.
Naturwissenschaften (Germany), Vol. 48, No. 2, 39-40 (1961).
In German.

Air sensity measurements out to about 1500 km. are obtained from observations of a number of satellites, including Echo 1. The sensity above 1000 km. decreases with height at an ever-decreasing rate. Undulations in the density/height curve at about 250 km. and 180 km. are given probable explanations. A.Boksenberg

10319 MEASUREMENT OF THE TEMPERATURE IN THE UPPER ATMOSPHERE TO 150 km IN A ROCKET EXPERIMENT. J.E.Blamont, T.M.Donahue and M.L.Lory.
Phys. Rev. Letters (USA), Vol. 6, No. 8, 403-4 (April 15, 1961).

Temperatures for the height range 100-150 km, deduced from observations of sunlight resonantly scattered from sodium atoms

in a cloud ejected from a rocket, are in agreement with the low values derived from auroral and airglow spectroscopic observations.
G.M.Brown

10320 THE FLOW ABOUT A CHARGED BODY MOVING IN THE LOWER IONOSPHERE. R.R.Hunziker.
J. Aero/Space Sci. (USA), Vol. 27, 935-42 (1960).

The flow about an electrically charged body travelling at high speeds through the lower ionosphere is analysed. A simple gas model composed of electrons, ions, and neutral particles is used and the hydrodynamic description given is based on Maxwell's transfer equations for a mixture. The conditions under which local statistical equilibrium can be assumed are discussed, and different approaches to determine the gasdynamic force in the subsonic, supersonic, and hypersonic cases are indicated. The reciprocal action of the electric field of the flow on the body is also analysed, and a formula for the resultant electric force is given. The total force on the body is equal to the sum of the gasdynamic force and the electric force. The negative potential acquired by a plant body is also calculated. Finally, the lack of validity of Debye's linearization in this case and the solution of the exterior nonlinear problem which characterize the electric potential and the electron distribution are discussed.
Mathematical Reviews

10321 MAGNESIUM AND CALCIUM IONS IN THE UPPER ATMOSPHERE OF THE EARTH. V.G.Istomin.
Dokl. Akad. Nauk SSSR, Vol. 136, No. 5, 1066-8 (Feb. 11, 1961).
In Russian.

Magnesium ions, of isotopes 24 and 26, and calcium ions were detected by rocket-borne mass spectrometers at heights between 100 and 120 km. The distribution of Mg$^+$ is sharply peaked at 105 km, at which height these ions form 17 % of the total ionic concentration. The greatest concentrations of Mg$^+$ and Ca$^+$ ions are given as 13 600 cm^{-3} and 540 cm^{-3} respectively. H.Rishbeth

10322 THE TOTAL ELECTRON CONTENT OF THE IONOSPHERE DURING THE MAGNETIC DISTURBANCE OF NOVEMBER 12-13 1960. G.N.Taylor.
Nature (GB), Vol. 189, 740-1 (March 4, 1961).

The content was measured using Faraday fading of a radio wave reflected by the moon. During a magnetic storm, the number of electrons was at a low value during the day following the sudden commencement. Comparison with foF2 values, which also decreased severely, indicate a scaling down of the electron density distribution throughout the ionosphere, rather than a redistribution of ionization within it.
H.J.A.Chivers

10323 A NEW METHOD FOR CALCULATION OF N(h). PROFILES FROM IONOSPHERIC L'(f) CURVES. H.Hojo.
Nature (GB), Vol. 189, 562-3 (Feb. 18, 1961).

A preliminary presentation of a method which permits simpler computer programming for the determination of profiles.
H.J.A.Chivers

10324 ARTIFICIAL ELECTRON CLOUDS. VI. LOW ALTITUDE STUDY, RELEASE OF CESIUM AT 69, 82 AND 91 km. J.Pressman, F.F.Marmo and L.M.Aschenbrand.
Planet. Space Sci. (GB), Vol. 2, No. 4, 228-37 (Aug., 1960).

For previous parts see Abstr. 6608-12 of 1961. A series of three artificial electron clouds was created at Holloman Air Force Base, New Mexico at 69, 82 and 91 km in May, 1958 by the day-time thermo-chemical release of caesium. The electron cloud was created by both thermal and photo-ionization. A lower limit for the effective duration of electron clouds for this kind of release was found to be 70 km. The short duration at low altitudes is caused by both the rapid chemical consumption of the caesium atoms thereby preventing photo-ionization and the rapid electron attachment followed by mutual neutralization. The coefficient of mutual neutralization is estimated to be 10^{-7}-10^{-8} cm^3 sec^{-1}. The mathematical model employed appears to be reasonably valid.

10325 SOME ASPECTS OF SPORADIC-E AT MID-LATITUDES. G.G.Bowman.
Planet. Space Sci. (GB), Vol. 2, No. 4, 195-211 (Aug., 1960).

Evidence is presented to suggest that the f_oE_s value tends to be high at positions in the E_s-layer where trough slope-lines and crest slope-lines of F2-layer irregularities meet the E_s-layer. These slope-lines are drawn through the troughs and crests, respectively, of the characteristic kinks in the F2-layer ionization contours, which are associated with F2-layer irregularities. A rotating-loop direction-finding system has allowed an estimation of the distribution of ionization, which gives rise to Sporadic-E echoes. Analysis of Sporadic-E occurrence, on two occasions, suggests that the reflecti surfaces are frontal in nature, the fronts having a separation from each other of some tens of kilometres, and probably existing as closed curves, with diameters of the order of several hundreds of kilometres. A possible association between these structures and the occurrence of the green line of the airglow, is discussed. A distribution of ionization, which will give contours showing "clouds" of ionization at some frequencies and a ripple structure at other frequencies, is proposed, in an endeavour to explain the apparent dual nature of Sporadic-E occurrence. The evidence seems to indicate that the mechanism operating at the E_s-layer level, producing the phenomenon of Sporadic-E, is the same as that which produces the F2-layer irregularities which are responsible for "Spread-F".

10326 FADING OF C.W. SIGNALS AS A MEANS OF SPREAD F STUDY.
M.S.V.Gopal Rao, B.Ramachandra Rao and P.Ramachandra Rao Par
Current Sci. (India), Vol. 29, No. 8, 304-5 (Aug., 1960).

At night the fading rate of 11.7 Mc/s c.w. signals reflected obliquely from the F region is markedly increased when spread F conditions are observed by vertical incidence sounding.
H.Rishbeth

10327 TRIPLE SPLITTING WITH THE F2-REGION OF THE IONOSPHERE AT HIGH AND MID-LATITUDES.
G.G.Bowman.
Planet. Space Sci. (GB), Vol. 2, No. 4, 214-22 (Aug., 1960).

The occurrence of the third (z-ray) component of the F2-trace on ionograms is investigated at high- and mid-latitudes. Diurnal variations show a systematic shift, with magnetic inclination, of the time of maximum occurrence. Seasonal variations show a winter maximum, and an inverse sunspot-cycle relationship exists. Maximum occurrence appears between a magnetic inclination of 70° and 80° with a fall-off either side. Evidence is presented to suggest a z-ray association with "Spread-F" fronts, and a possible mechanism for the recording of the z-ray trace at the transmitter site is described. This involves longitudinal propagation of the o-mode at its normal reflection level, coupling at this point, and ultimate reflection for the z-ray mode as a result of sloping ionization contours belonging to "Spread-F" fronts extending in directions perpendicular to the magnetic meridian. As association with v.l.f. emissions ("dawn-chorus") is discussed.

10328 HYDROGEN EMISSIONS DURING THE PERIOD NOVEMBER 9-16, 1960. R.Montalbetti and D.J.McEwe
Canad. J. Phys., Vol. 39, No. 4, 617-19 (April, 1961).

Some results obtained at Churchill, Manitoba (geomag. lat. 68° N) with a photoelectric scanning photometer arranged to record continuously the night-airglow emission through a narrow-band interference filter centred on H_β (4861 A) are discussed. Five positions along a meridional line are scanned in succession, starting at 10° above the N horizon, during a total time of ~ 5 sec. Within the time resolution achieved, no systematic motion of the emission was detected, although strong bursts of H_β radiation occurred simultaneously along the entire length of scan. These are found to follow strong radio-wave absorptions with a time delay of ~ $\frac{1}{2}$ hr. The mean intensity of the H_β emission normally observed was ~ 150 R, but on the night of November 12-13 an unusual increase to a peak value of 600 R (~ 10^8 protons/cm^{-2} sec^{-1}) was reached during a magnetic storm. This maximum is similar to that recorded in February 10-11, 1958 when, during an intense geomagnetic disturbance, a peak intensity of H_β emission of 850 R was attained.
D.R.Barber

10329 ENHANCEMENT OF NIGHT-SKY MOLECULAR NITROGEN EMISSION IN POLAR CAP ABSORPTION EVENTS. B.P.Sandford.
Nature (GB), Vol. 190, 245-6 (April 15, 1961).

The author summarizes some of the work done on night-sky emissions at Thule, Greenland, and at the South Pole, with emphasis on the behaviour of the first negative band of ionized nitrogen at 3914 A. Curves of the relative intensity of this band versus time are given, showing the correlation between the variations in intensity and the occurrence of solar flares, sudden magnetic storms, and polar absorption events. Enhancements up to 100 times normal minimum value are recorded at times coincident with the maximum magnetic storm intensity. The author concludes that the emissions appear to originate at altitudes near or below 100 km. M.Kasha

10330 AUTOMATIC ELECTROPHOTOMETRIC RECORDING OF NIGHT-SKY LUMINANCE. A.N.Otto.
Pribory i Tekh. Eksper. (USSR), 1958, No. 1, 130-1 (Jan.-Feb.)
In Russian.

Unlike many photoelectric scanning photometers yielding

es of sky brightness at a series of fixed time-intervals through-
the night, this apparatus, designed for operation during the
Y., gives a continuous record of any changes of sky intensity
may occur at any time during the night. The instrument
loys a cooled photomultiplier coupled to a specially-designed
rent amplifier, and a pen recorder. An example is given of a
ord made on the night of 17-18 July 1956. [English translation
Instrum. Exper. Tech. (USA), No. 1, 145-6 (Jan.-Feb., 1958;
.. April, 1959)]. D.R.Barber

0331 ORIENTATION OF POLAR AURORAS.
J.V.Denholm and F.R.Bond.
tral. J. Phys., Vol. 14, No. 1, 193-5 (March, 1961).

Determination of the orientation of homogeneous auroral arcs
bands at four Antarctic stations situated within the southern
oral zone shows that at each there is a diurnal variation
gesting rotation with the sun. The results are also consistent
the suggestion that auroral forms lie along the lines of flow
ne geomagnetic disturbance current system. G.M.Brown

0332 OBSERVATIONS OF AURORAL IONIZATION DURING THE PERIOD NOVEMBER 11-16, 1960.
.Serson and B.C.Blevis.
ad. J. Phys., Vol. 39, No. 4, 622-5 (April, 1961).

Histograms are given showing comparisons between auroral
ar observations (echo amplitudes on 488 Mc/s and 944 Mc/s;
luminosities at 5577 A and 3914 A) and magnetic disturbance
ordings, made at Moosonee, Ontario. Strong features appear
oth the radar and photometric records which are associated
large changes in the magnetic field. G.M.Brown

10333 AURORAL OBSERVATIONS AT HALLEY BAY, ANTARTICA, DURING 1959.
.Sheret and G.M.Thomas.
ure (GB), Vol. 189, 826 (March 11, 1961).

From visual and all-sky camera records of the aurora at the
base (66°S Geomagnetic) taken during 1956-59, the suggestion
there is a simple geometrical connection between the position
e quiet arc zones in the two hemispheres and the horns of
Van Allen belts of geomagnetically trapped radiation appears
e substantiated. R.W.Nicholls

0334 THE TIME DELAY OF THE RED [OI] LINES IN THE AURORA. A.Omholt.
et. Space Sci. (GB), Vol. 2, No. 4, 246-8 (Aug., 1960).

A detailed numerical analysis of Stoffregen and Derblom's
rds of the red line λ 6300 and the N_2^+ band λ 4278 were under-
n. The red line is delayed relatively to the violet band, the
age delay time being 150 to 200 sec. The average intensity
I(6300) /I(4278) is about 4.6 for these records. These results
have important consequences for the theory of the excitation
deactivation of the $O(^1D)$ atoms, which is discussed.

0335 A PRELIMINARY MODEL FOR THE VARIATIONS OF UPPER AIR DENSITIES. H.K.Paetzold.
ure (GB), Vol. 190, 35-6 (April 1, 1961).

In addition to its dependence on altitude, air density above
km is controlled by (1) short-wave solar u.v. radiation as shown
the correlation with sunspot number, (2) the day—night effect
se amplitude increases with height, and (3) the annual and semi-
ual effect probably caused by interaction with the interplanetary
ma. Minor influences are (4) magnetic activity and (5) latitude
season. The author proposes three functions to represent the
t three of these effects, and in two graphs shows their variations
orm with time and height. Allowing, further, for change with
tude of the day—night effect and the annual effect, and using
ble of standard densities for eight heights up to 1500 km,
roposes a composite function from which a first approximation
he air density can be calculated. This deals with changes
ing a time scale greater than one day; solar flares produce
itional short period changes. J.M.Stagg

0336 SOLAR WIND AND THE GEGENSCHEIN.
E.R.Harrison.
re (GB), Vol. 189, 993-4 (March 25, 1961).

Recently, Biermann (1951) and Parker (1958, 1959) suggested a
city of ~ 500 km/sec for the solar wind in the vicinity of the
h's orbit. Also, data derived from optical measurements of the
htness, and extent of the gegenschein, or counterglow, in the
t sky reveal that its brightness undergoes considerable varia-
s with time; that it occupies a roughly elliptical patch of sky
$< 6^\circ$ angular size; and that there exists a small and variable
lacement of its centre to the W of the midnight meridian, the mean value being $\sim 3^\circ$. These properties suggest strongly that the gegenschein is, in fact, a luminous magnetic tail to the earth, its luminosity being due to the excitation of entrapped atmospheric-type atoms. Taking the earth's orbital velocity to be 30 km/sec, and the observed displacement of the gegenschein as 3°, a velocity of ~ 600 km/sec is found for the interacting solar wind in good accord with Biermann's, and Parker's estimate above. D.R.Barber

10337 A RADIO WAVE MECHANISM TO ACCOUNT FOR THE KNOWN DISTRIBUTION OF VAN ALLEN BELTS ABOUT THE EARTH. J.M.Boyer.
Nature (GB), Vol. 190, 597-9 (May 13, 1961).

It is supposed that standing wave patterns, set up near the earth by solar electromagnetic radiation (of wavelengths comparable to the earth's radius), can trap energetic particles from the sun. The effects of the earth's magnetic field are entirely neglected. H.Rishbeth

10338 THE CONNECTION BETWEEN MEASUREMENTS WITH THE AID OF CHARGED-PARTICLE TRAPS BY THE SOVIET COSMIC ROCKETS AND MEASUREMENTS OF THE MAGNETIC FIELD BY THE AMERICAN SATELLITE "EXPLORER VI" AND THE ROCKET "PIONEER V".
K.I.Gringauz and S.M.Rytov.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 1, 48-51 (Nov. 1, 1960).
In Russian.

For abstract, see Abstr. 6644 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1225-8 (May-June, 1961)].

GEOMAGNETISM

10339 ON A POSSIBLE MECHANISM FOR THE CAPTURE OF CHARGED PARTICLES IN A MAGNETIC FIELD.
V.M.Vakhnin and G.A.Skuridin.
Dokl. Akad. Nauk SSSR, Vol. 135, No. 6, 1354-7 (Dec. 21, 1960).
In Russian.

For abstract, see Abstr. 4699 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 5, No. 6, 1296-9 (May-June, 1961)].

ACTIVITY OF COMETS' TAILS DURING LOW GEOMAGNETIC ACTIVITY. See Abstr. 7981

10340 GEOMAGNETIC VARIATIONS BETWEEN NOVEMBER 12 AND NOVEMBER 16, 1960. E.R.Niblett.
Canad. J. Phys., Vol. 39, No. 4, 619-22 (April, 1961).

The hour to hour variation of representative magnetic elements over the five days 12 to 16 Nov. 1960 is shown diagramatically for the Canadian observatories Victoria, Agincourt and Meanook south of the zone of maximum auroral frequency, and Baker Lake and Resolute north of that zone. During that period two considerable magnetic disturbances occurred, separated by a relatively quiet period: both disturbances followed a sudden commencement (s.s.c.). The curves of hourly values suggest that the principal disturbing electric currents were located in the auroral zone. A table gives details of the s.s.c's and the local K indices. J.M.Stagg

10341 SOLAR RADIO EVENTS AND GEOMAGNETIC STORMS.
L.D. de Feiter, A.D.Fokker, H.P.Th. Van Lohuizen and J.Roosen.
Planet Space Sci. (GB), Vol. 2, No. 4, 223-7 (Aug., 1960).

On the basis of a 24-hour patrol of solar radio noise established since the beginning of the International Geophysical Year, an identification is attempted of those solar flares which, an account of their associated radio responses, most probably were the cause of a geomagnetic storm. The cases for which the identification is considered reliable are listed. It appears that great integrated intensity of the radio outburst at centimeter, decimeter and meter wavelengths is the primary criterion for identifying the solar flares responsible. Most of these giant radio outbursts, to which the "radio importance" figure 3^+ is assigned, belong to the so-called type IV. Only a minor fraction of these events were accompanied by slow-drift bursts of type II. Of the important 3^+ radio outbursts about 60% were clearly associated with the subsequent sudden commencement of a geomagnetic storm. Conversely, about 50% of the sudden commencements of a storm could be related to an important radio event. Some reasons why in a particular case the storm—outburst association may fail to exist are mentioned.

BIOPHYSICS . PHYSIOLOGICAL PHYSICS

10342 ACCELERATORS IN BIOLOGY AND MEDICINE.
H.L.Andrews.
Nuclear Instrum. and Methods (Internat.), Vol. 6, No. 1, 96-100 (Dec., 1959).

The desirable features of an accelerating machine are listed and considered in the light of requirements both for radiation biology and radiotherapy. The need for both electron and photon beams with both continuous and pulsed outputs is stressed as well as the need for built-in pre-set dosemeters. Some of the practical problems which are frequently not considered sufficiently by some workers, such as uniformity of the radiation field used, are considered. J.R.Mallard

10343 THE POSSIBILITY OF THERAPEUTIC APPLICATIONS OF BEAMS OF NEGATIVE π-MESONS.
P.H.Fowler and D.H.Perkins.
Nature (GB), Vol. 189, 524-8 (Feb. 18, 1961).

The capture of π^--mesons by light elements such as C^{12}, N^{14} and O^{16}, of which biological tissue is mainly composed, leads to the release of a proportionately high amount of energy in the form of α-particles with very short range (<1 mm). The range of 52 MeV π^--mesons in tissue is about 10 cm, and the points of arrest are then distributed in a target area of about 2 cm^2 normal to the axis of the beam. Such a beam, in which the release of energy is highly localized, would therefore offer considerable advantages in radiotherapy. All the necessary data are not yet available, but on the basis of what is known it can be predicted that the depth-dose distribution (i.e. the radiation dose delivered at a specified distance below the skin) would be "onion shaped" rather than the diverging cone associated with available methods of treatment. No source of π^--mesons in existence is capable of delivering sufficient intensity of primary beam to keep exposure times within reasonable limits but it is considered that modifications could be made to a machine such as the Liverpool cyclotron which would reduce them to the same order as those now used in conventional X-ray therapy. C.B.Allsopp

DEVICE FOR THE MEASUREMENT OF RADIOACTIVITY IN THE HUMAN BODY. See Abstr. 9819

Hearing . Speech

10344 SUPRA-AURAL CUSHIONS IN AUDIOMETRY.
R.L.Sergeant and J.D.Harris.
J. Acoust. Soc. Amer., Vol. 33, No. 7, 966 (July, 1961).

Differences in median audiometric thresholds for 20 subjects resulting from embedding earphones in the standard MX-41/AR muff and in the Willson "Sound Barrier" supra-aural muff are presented. Applying these corrections to the Willson muff with its much superior sound-attenuation properties makes possible threshold audiometry in much noisier workspaces than heretofore.

10345 HEARING LOSS DUE TO GUN BLAST.
J.C.Muirhead.
J. Acoust. Soc. Amer., Vol. 32, No. 7, 885 (July, 1960).

A shock wave subjects the ear drum to an oscillatory, rather than a single transient pressure load. It is suggested that the frequency range in which hearing loss due to gun blast occurs is related to the frequency of this pressure oscillation.

Vision

10346 OPTIMAL ENCODING OF THE VISUAL IMAGE.
M.M.Benarie.
J. Opt. Soc. Amer., Vol. 51, No. 3, 371-2 (March, 1961).

A simple type of information theory is tested with measurements of the extent of the scotopic visual field. R.A.Weale

10347 NOMENCLATURE OF RETINAL GANGLION CELLS.
H.Piéron.
J. Opt. Soc. Amer., Vol. 51, No. 4, 458 (April, 1961).

A new nomenclature of retinal ganglion cells is proposed based on (alleged) sensory effects which the writer thinks they mediate. R.A.Weale

PHOTOCONDUCTION IN A HINDERED CIS-ISOMER OF β-CAROTENE AND ITS RELATION TO A THEORY OF THE VISU RECEPTOR PROCESS. See Abstr. 8965

10348 EFFECT OF OVER-ALL DURATION ON ACUITY THRESHOLD AND BRIGHTNESS MATCHING TASKS.
K.Gibbins.
J. Opt. Soc. Amer., Vol. 51, No. 4, 457-8 (April, 1961).

Previous data obtained by Nachmias (Abstr. 9192 of 1958) are re-interpreted: it is shown that the variations of visual acuity an brightness-matches with time are similar. R.A.We

10349 VISUAL RESPONSES TO TIME-DEPENDENT STIMUL II. SINGLE-CHANNEL MODEL OF THE PHOTOPIC VISUAL SYSTEM. D.H.Kelly.
J. Opt. Soc. Amer., Vol. 51, No. 7, 747-54 (July, 1961).

A relatively simple model of the first two links in the visual receptor system is proposed in order to explain the data reported Pt I (Abstr. 6674 of 1961) on amplitude sensitivity to sinusoidally flickering stimuli at photopic adaptation levels of white light. The model consists of a linear filtering stage followed by a nonlinear pulse-encoding stage. The first stage is regarded as essentially "noiseless" at photopic levels; amplitude thresholds are treated a thresholds for the transmission of variable intervals between puls With the aid of the model, suprathreshold responses can be inferr from the measured threshold behaviour. In this way, transient re sponses comparable with various other psychophysical, neural, an electroretinographic data are predicted; the resulting agreement i considered fairly good in view of the parsimony of the proposed model.

10350 INTERRELATIONSHIPS OF BACKGROUND AREA, TARGET AREA, AND TARGET LUMINANCE IN THEI EFFECT ON THE CRITICAL FLICKER FREQUENCY OF THE HUMAN FOVEA. P.J.Foley.
J. Opt. Soc. Amer., Vol. 51, No. 7, 737-40 (July, 1961).

An investigation was carried out to determine the effects of background area (A_B), target area (A_T) and target luminance (B_T) the critical flicker frequency and the interrelationships between these variables. CFF increases linearly with $\log A_B$, $\log A_T$ and $\log B_T$. Background area affects CFF much less than target area c target luminance. There are no interactions between the three va ables. An index of spatial summation 0.57 was derived from the data and is compared with other indexes of spatial summation give for the human fovea.

10351 PREDICTION OF THE EFFECT OF LIGHT-TIME FRACTION ON THE CRITICAL FLICKER FREQUENC AN INSIGHT FROM FOURIER ANALYSIS.
K.Gibbins and C.I.Howarth.
Nature (GB), Vol. 190, 330-1 (April 22, 1961).

A Fourier analysis of intermittent stimuli to yield a steady (adapting) and an alternating component makes it possible to ration alize apparently disconnected data on fusion frequency.

R.A.Wea

10352 DETERMINERS OF THE DRIFT OF THE EYE DURING MONOCULAR FIXATION. J.Nachmias.
J. Opt. Soc. Amer., Vol. 51, No. 7, 761-6 (July, 1961).

The nature of the drift was investigated by recording vertical and horizontal components of eye movements under a variety of viewing conditions. Extinguishing the fixation mark, or placing it 30 cm instead of at optical infinity was found to increase the net absolute drift rate, as well as to alter the preferred direction of drift. This suggests, as do some previous findings, that the drift o the eye is at least indirectly influenced by visual factors. Changin the position of the viewing eye in the head produced systematic shi in the preferred direction of drift. The relationship of these findin to various aspects of monocular and binocular fixation were discussed.

10353 A VARIABLE MULTIDIMENSIONAL DARK ADAPTOMETER. J.H.Hollis.
J. Opt. Soc. Amer., Vol. 51, No. 7, 794-7 (July, 1961).

A visual adaptometer designed for the investigation of several parameters of adaptation is described. The apparatus is relativel simple and inexpensive to construct. Its utility and flexibility mak it a useful instrument for research and classroom demonstration.

10354 SINE-WAVE RESPONSE OF THE VISUAL SYSTEM.
I. THE MACH PHENOMENON.
M.Lowry and J.J.DePalma.
Opt. Soc. Amer., Vol. 51, No. 7, 740-6 (July, 1961).

In order to develop a complete specification for the appraisal
the quality of a photographic system by the use of sine-wave
sponse functions, the sine-wave response of the complete visual
stem must also be known. A method has been worked out for
termining the above-mentioned response of the eye. Whenever
e eye views a diffuse luminous boundary in which a sudden change
luminance gradient occurs, a bright line appears at the junction
the gradient and the higher luminance, and a dark line at the junc-
n of the gradient and the lower luminance. This phenomenon is a
rely subjective one, because physical measurements of the lumin-
ces involved show no luminance higher or lower than the two be-
een which the gradient exists. A visual slit photometer has been
ilt with which the subjective intensity distribution may be evalu-
ed directly. By application of Fourier analysis, the objective and
bjective intensity distributions have been combined to yield the
ne-wave response of the visual system.

10355 APPEARANCE OF MACH BANDS WITH A MOTIONLESS RETINAL IMAGE.
.A.Riggs, F.Ratliff and U.T.Keesey.
Opt. Soc. Amer., Vol. 51, No. 6, 702-3 (June, 1961).

Mach bands were viewed both with and without the retinal
nage immobilized. The mean disappearance times, though shorter
the former condition, suggest that the typical appearance of the
ovements is independent of the presence or absence of fixational
ye-movements.
R.A.Weale

10356 PROXIMITY FACTOR IN THE JUDD COLOR DIFFERENCE FORMULA. A.C.Traub and I.Balinkin.
Opt. Soc. Amer., Vol. 51, No. 7, 755-60 (July, 1961).

When two coloured samples are to be compared visually, the size of the perceived lightness difference will in general depend upon the spatial proximity of the samples. This is taken into account in the Judd formula for colour difference [American Journal of Psychology, Vol. 52, 418 (1939)] which includes a proximity factor. This factor weights measured reflectance difference so that the perceived lightness differences predicted by the formula vary with the spatial proximity of the samples. A few tentative values have been assigned by Judd for various separations. A continuous, empirical expression for the proximity factor has been found as a function of angular separation of the samples under specified viewing conditions. A divided visual field was used, with variably separable halves. The halves could be interchanged without the knowledge of the observer, who was required to identify the darker half many times at each of several values of separation. The observer's difficulty of identification increased with increasing dividing linewidth and was measured statistically in terms of errors of identification. From the error data and certain assumptions, a relationship between proximity factor and angular separation was deduced. A few tests were made in order to study possible effects of dividing linewidth on chromatiticy discrimination. Under the particular test conditions used, no effect was observed.

10357 SHAPE OF THE RED AND GREEN COLOR ZONE GRADIENTS. M.M.Connors and P.A.Kelsey.
J. Opt. Soc. Amer., Vol. 51, No. 8, 874-7 (Aug., 1961).

Colour sensitivity at the boundaries of the red and green zones along the 270° meridian was explored by a cumulative frequency-of-seeing method. The green zone was found to fall in a narrower range and to end closer to the fovea than the red zone. Significant variations of peripheral sensitivity to red were found with all observers. For both red and green, the greatest number of irregularities were found in those curves which extended well into the periphery.

TECHNIQUE . MATERIALS

10358 THE INFULENCE OF THE MECHANICAL PROPERTIES OF A SOLID ON THE RATE OF ULTRASONIC MACHINING.

N.M.Rostovtsev and G.I.Epifanov.
Dokl. Akad. Nauk SSSR, Vol. 136, No. 4, 807-9 (Feb. 1, 1961). In Russian.

For abstract, see Abstr. 9241 of 1961. [English translation in: Soviet Physics—Doklady (USA), Vol. 6, No. 2, 153-5 (Aug., 1961)].

10359 USE OF ULTRASOUND IN WELDING OF COPPER.

R.I.Garber, L.M.Polyakov and G.N.Malik.
Fiz. Metallov i Metallovedenie (USSR), Vol. 10, No. 4, 590-6 (Oct., 1960). In Russian.

Irradiation with 19.5 kc/s ultrasound accelerated formation of strong joints between copper pieces pressed together in vacuum at temperatures below the melting point of copper. Microstructure and elastic deformation of the joints were studied.

A.Tybulewicz

10360 AN INSTRUMENT TO SHARPEN MICROTOME KNIVES.

A.L.Sims.
J. sci. Instrum. (GB), Vol. 38, No. 6, 246-7 (June, 1961).

This instrument was designed to save the time spent in sharpening microtome knives by hand. It sharpens by simultaneous backwards and forwards and side to side movements of the knife over an abrasive plate. The movement is derived from an electric motor. The whole instrument is portable and requires no attention except to turn the knife over periodically. An adjustable steel toe allows the facet angle of the knife edge to be set correctly. This disposes of the dangerous operation of fitting to the knife the split cylindrical backing piece supplied by the knife-makers for this purpose. In order that the knife shall not be subjected to the stresses of clamping it is held in position on the abrasive surface by cylindrical permanent magnets, which also act in keeping the knife edge in contact with the abrasive surface with an even constant pressure. The use of magnets also facilitates the placing of the knife in its position for sharpening and its removal therefrom. It is shown that the repeated examination of the edge of the knife by microscope during sharpening is necessary.

10361 MECHANICAL TRACE READER.

E.W.Northover.
J. sci. Instrum. (GB), Vol. 38, No. 6, 248-9 (June, 1961).

A simple mechanical trace reader is described that enables deflections recorded on paper or film to be read off, on a dial gauge, in any desired units when a movable cursor is set to the required points on the trace. Its use is illustrated for evaluating recorded temperatures, at various points and times, in a thermal model for the study of heat flow in the strata surrounding a mine airway. The trace reader gives a direct indication of the temperature difference ratio $(\theta_r - \theta_0)/(\theta_v - \theta_0)$, where θ_r is the temperature at the point in question and θ_0 and θ_v are fixed temperatures. It can be used in many other applications, provided that there is a linear relationship between the recorded quantity and trace deflection.

10362 IMPROVED ADHESION OF METALLIC FILM DEPOSITED ON QUARTZ IN VACUO.

A.M.Il'inskii.
Pribory i Tekh. Eksper. (USSR), 1958, No. 1, 144 (Jan.-Feb.). In Russian.

Improved adhesion between the quartz plate and the metal electrode in quartz transducers for ultrasonic applications was obtained by first coating the quartz with BF-4 adhesive diluted in ethyl alcohol (2-3% dry substance). This was applied in three successive dip coatings before depositing the metal film by evaporation in vacuum in the normal way. The coating was subsequently polymerized by heating. [English translation in: Instru exper. Tech. (USA), No. 1, 160 (Jan.-Feb., 1958; publ. April, 1959)

W.Steckelmache

10363 ELECTROMAGNETIC METHODS OF TESTING METALS.

R.Hochschild.
Progress of non-destructive testing. Vol. 1 (see Abstr. 9238 of 1961) p. 57-109.

A review of the testing of metals, including ferromagnetics, b means of alternating magnetic fields. After a short historical introduction the basic principles of eddy currents in non-ferromagnetic metals, domain phenomena in ferromagnetic metals, ski effect, and fields and currents in a conducting cylinder are considered. A section on signal analysis discusses impedance analys calculations of coil impedance, phase-sensitive detectors, test coi system design, and response time and test speed. In the final section factors affecting resistivity are considered, and applicatio to alloy and heat treatment identification, strength and hardness, and testing of ferromagnetic metals are discussed.

J.B.Bir

10364 DESIGN AND CONSTRUCTION OF MULTI-RING APPARATUS FOR USE AT HIGH PRESSURES.

E.B.Christiansen, S.S.Kistler and W.B.Gogarty.
Rev. sci. Instrum. (USA), Vol. 32, No. 7, 775-9 (July, 1961).

A derivation is presented of equations which can be used in t design of high-pressure apparatus utilizing multi-ring support. T use of these equations is illustrated by the design calculation for a multi-ring apparatus known as the anvil assembly. The particula assembly described uses three rings for external support. This assembly is capable of developing average pressures of 160 000 at for minimum periods of two weeks. The methods and materials used in the fabrication of the assembly are also presented.

10365 ELECTRICAL LEADS FOR PRESSURE VESSELS TO 3 KILOBARS.

R.H.Cornish and A.L.Ruoff.
Rev. sci. Instrum. (USA), Vol. 32, No. 6, 639-42 (June, 1961).

A convenient labour-saving method of introducing up to eight o more electrical leads into a one-half inch diameter pressure chamber (which is applicable with liquid media to pressures in exce of 30 kilobars) is described.

LIST OF JOURNALS

The following list supplements the List of Journals published with the January number of Vol. 64 (1961). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free. The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

J. Joint Panel Nuclear Marine Propulsion (GB)	Journal of the Joint Panel on Nuclear Marine Propulsion Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, E.C.3.
Wear (Netherlands)	Wear Elsevier Publishing Company, 110-112 Spuistraat, Amsterdam.

NEW JOURNAL

Kybernetik (Germany)	Kybernetik Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf (West Berlin); Neuenheimer Landstrasse 28-30, Heidelberg. Vol. 1, No. 1, dated January, 1961.

CHANGE OF TITLE

Canad. Stand.	CSA News Bulletin [Amalgamates CSA Quarterly Bulletin and CSA News with issue dated Vol. 1, No. 1, April, 1961]. Canadian Standards Association, 235 Montreal Road, Ottawa 2, Ontario.

ABSTRACT JOURNAL

Copper Abstracts	Copper Abstracts Copper Development Association, 55 South Audley Street, London, W.1., England.

ERRATA

Author Index (Nov., 1960): after "Morita,T." delete "18205"; insert "Moriya,T., 18205".
Abstr. 8701 (1960) line 1: for "VIRAL" read "VIRIAL".
Abstr. 8116 (1961) line 3: for "H.S.Ramo Rao" read "H.S.Rama Rao".
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Abstr. 9224 (1961) line 3: for "No. 11" read "No. 4".
Abstr. 9382 (1961) line 2: for "K.Heizinger" read "K.Heinzinger".
Abstr. 9683 (1961) line 3: for "D.Deschamps" read "D.Descamps".

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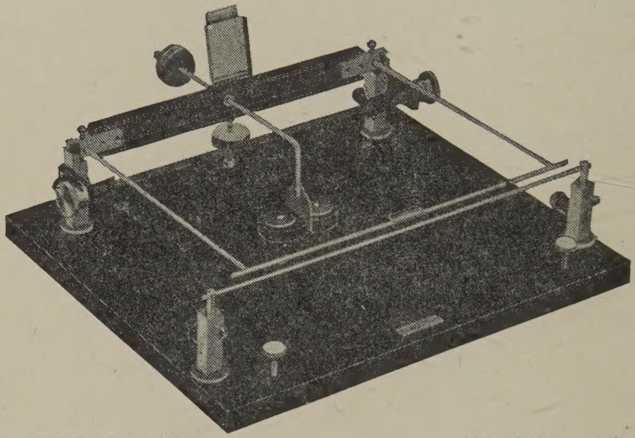

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